Discussion Papers
Department of Economics
University of Copenhagen

No. 15-06

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ISSN: 1601-2461 (E)

Acts of God? Religiosity and Natural Disasters Across Subnational World Districts

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April 13, 2015

Abstract

Religiosity affects everything from fertility and health to labor force participation and productivity. But why are some societies more religious than others? To answer this question, I rely on the religious coping theory, which states that many individuals draw on their religious beliefs to understand and deal with adverse life events. Combining subnational district level data on values across the globe from the World Values Survey with spatial data on natural disasters, I find that individuals become more religious when their district was hit recently by an earthquake. And further, I find that this short-term effect co-exists with a long-term impact: Using data on children of immigrants in Europe, I document that high religiosity levels evolve in high earthquake risk areas, and are passed on across generations to individuals no longer living in these areas. The impact is global: earthquakes increase religiosity both within Christianity, Islam, and Hinduism, and within all continents. I document that the results are consistent with the literature on religious coping and inconsistent with alternative theories such as insurance or selection.

Keywords: Religiosity; Natural disasters; Religious coping

JEL Classification codes: Z12; Q54; N30; R10

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1 Introduction

The majority of the World population is religious. 69% regard themselves as religious, 83% believe in God.[1] And this matters for the decisions we make. Indeed, differences in religiosity have been associated with differences in e.g., fertility, labor force participation, education, crime, and health, but also with aggregate economic outcomes such as GDP per capita growth.[2] A first order question is thus: Why are some societies more religious than others?

To answer this question, I rely on the religious coping theory, which has been put forward by scholars within psychology, sociology, and anthropology. Religious coping refers to the activity of drawing on religious beliefs to understand and deal with adverse life events.[3] Praying to God for relief or attributing the event to an act of God are examples of religious coping. In an attempt to validate the theory, existing empirical evidence shows that individuals hit by various adverse life events are more religious.[4]

This paper surmounts a major empirical challenge: being hit by adverse life events is most likely correlated with unobserved individual characteristics (like lifestyle), which in turn may matter for the individual's inclination to be religious.[5] Furthermore, by conducting the analysis on a global sample, this study explores the contention of philosophers such as Karl Marx and Sigmund Freud that *all* religions evolve to provide individuals with a higher power to turn to in times of hardship.[6] So far, the samples used in the empirical literature are either narrow subsets of a population or few regions in Western countries.

This paper exploits earthquakes as a source of exogenous adverse life events that hit individuals across the globe at varying strengths.[7] Across 600-900 subnational districts of

[1] Numbers calculated from the last decade of the pooled WVS / EVS 2004-2014.

[2] For economic correlates of religiosity, see Guiso *et al.* (2003), Gruber (2005), and Gruber & Hungerman (2008) for empirical investigations or Iannaccone (1998), Lehrer (2004), and Kimball *et al.* (2009) for reviews of the literature on the impact of religiosity on economic outcomes. For papers on the impact of religiosity on aggregate growth rates, see McCleary & Barro (2006) or Campante & Yanagizawa-Drott (2013).

[3] What I label religious coping has been called many things across time, space, and academic disciplines. For instance, the religious comforting hypothesis or the religious buffering hypothesis. Also the uncertainty hypothesis is a special case of religious coping. I choose the term religious coping from within psychology, used among others by the psychologist Kenneth Pargament in his influential book about religious coping, Pargament (2001).

[4] See e.g., Ano & Vasconcelles (2005), Pargament *et al.* (1990), and Pargament (2001) for reviews.

[5] Some recent micro studies do address the endogeneity concern in small samples. E.g., Norenzayan & Hansen (2006) across 28 western students or Sibley & Bulbulia (2012) across 5 regions of New Zealand.

[6] Feuerbach (1957), Freud (1927), Marx (1867), Norris & Inglehart (2011).

[7] Among all natural disasters, earthquakes are particularly useful to analyze as they have proven impossible to predict and since data on earthquakes is of a high quality. Other types of disasters such as wars, economic crises, and epidemic diseases, hit societies on a global scale, and people probably also react to these events by turning to their religion. But these events cannot be regarded as natural experiments; they are endogenous to various factors, potentially biasing the results.

the World, I first show that individuals are more religious when living in districts hit more frequently by earthquakes, even accounting for actual recent earthquakes.[8] The measures of religiosity include answers to questions such as "How important is God in your life?" or "Do you believe in an Afterlife?" from the pooled World Values Survey / European Values Study. I control for country and time fixed effects as well as individual and district level characteristics. The estimates indicate that increasing earthquake risk by 30 percentiles from the median in the earthquake distribution increases religiosity by 9 percentiles from the median in the religiosity distribution. The tendency is global: Christians, Muslims, and Hindus all exhibit higher religiosity in response to elevated earthquake risk, and so do inhabitants of every continent.[9]

A concern is that important district-level factors have been left out of the analysis, biasing the results. To address this concern, I exploit the time-dimension of the data to perform a difference-in-difference analysis, which confirms the causal effect: District-level religiosity increases when an earthquake hits. Results are robust to country-by-year fixed effects, individual level controls etc., and rather comforting, future earthquakes have no impact on current religiosity. The fact that earthquakes can still in modern days instigate intensified believing is illustrated by a Gallup survey conducted in the aftermath of the great 1993 Mississippi river floodings. The survey asked Americans whether the recent floodings were an indication of God's judgement upon the sinful ways of the Americans. 18 % answered in the affirmative (Steinberg (2006)).

An important issue is whether enhanced religiosity is merely a temporary phenomenon. Perhaps individuals respond to the stress caused by an earthquake by engaging in their religion and when the stress is over, they return to their previous level of religiosity. In fact, I do find evidence that the short term spike in religiosity after an earthquake, levels off after a while. However, the analysis documents a highly persistent residual impact: Children of immigrants are more religious when their mother came from a country located in a high earthquake risk zone, independent of the actual earthquake risk in their current country of residence. It seems that living in high-earthquake risk areas instigates a culture of religiosity, which is passed on to future generations like any other cultural value. The existence of a long term effect of earthquake risk is corroborated in the cross-district analysis: The impact

[8] The earthquake frequency measure is based on earthquake zones calculated by the UNEP/GRID, based on ground acceleration, duration of an earthquake, subsoil effects etc. I restrict the disaster measures to purely physically based measures, as for instance losses from natural disasters are potentially endogenous.

[9] Protestants engage in religious coping more than average, while Catholics do less. The sample of Buddhists is too small to be able to estimate an effect.

of long term earthquake risk is unaltered when controlling for actual recent earthquakes, but is smaller in districts that were hit by an earthquake within the last year.[10]

To test whether the results are due to religious coping, I carry out a set of detailed consistency checks. First, according to the literature on religious coping, individuals use their religion to cope mainly with unpredictable events, and less so with predictable ones.[11] Consistent with this, I find that tsunamis and volcanoes increase religiosity just as earthquakes, while storms, which are seasonal and thus much more predictable, do not imply increased believing. In addition, an earthquake that strikes a low risk district has a larger impact on religiosity compared to an earthquake that hits a high-risk district. A second testable implication of the religious coping hypothesis is the observation that individuals with more resources tend to engage less in religious coping, as they have access to a wider range of coping strategies (psychologist, buying a new house, moving, etc.), compared to those where religion is their only available coping strategy.[12] Corroborating this, I find that religiosity of educated, employed, and married individuals increases less when earthquake risk is higher compared to less educated, unemployed and unmarried individuals. However, also consistent with the literature, I find that these groups do react to earthquakes by increased believing, though to a lesser extent.[13] A third finding of the literature is that religious *beliefs* are used to a larger extent in religious coping and also seem to be more efficient in reducing symptoms such as depression, compared to church going which is used less as a coping strategy and also does not provide the same health benefits.[14] Consistent with this, I find that earthquake risk influences religious beliefs more than church going in all three analyses.

It is worth noting that the uncovered results are unlikely to be generated by selection; i.e. the notion that "non-believers" systematically abandon earthquake sites, thereby elevating the average district level religiosity in the aftermath of an earthquake. First, the results from the event study are difficult to explain in this context: I find a spike in religiosity after an earthquake, which abates over time. If this is due to selection, it requires atheists to move out every time an earthquake hits, but then move back in again after some time, only to move out again when the next earthquake hits. The spike *can* be explained in relation to

[10] Indeed, all main cross-sectional results include a dummy equal to one if an earthquake hit in the year or the year before the WVS-EVS interview.

[11] E.g., Malinowski (1948), Hood Jr (1977), Skinner (1948).

[12] Pargament (2001). This is in line with the related hypothesis by Norris & Inglehart (2011) about existential security: Individuals use their religion to cope with lack of security.

[13] See e.g., Koenig *et al.* (1988) and review by Pargament (2001).

[14] E.g., Miller *et al.* (2014), Koenig *et al.* (1988), Koenig *et al.* (1998).

religious coping: Praying reduces the stress caused by the earthquake, leveling off the need for prayer after a while. Second, if selection was the only thing going on, we would expect those moving out of high-earthquake-risk areas to be less religious. Assuming some passing on of values from adults to children, we would expect that children of immigrants from these areas were *less* religious. The results show that they are *more* religious.[15] Third, selection seems inconsistent with the finding that religiosity is less related to earthquake risk when a recent earthquake has hit. We would have expected the opposite: being hit again and again by earthquakes makes it more likely for people to abandon these areas.

The results do not seem to be due to social insurance either; i.e. the notion that individuals affected by earthquakes go to their church for aid. The "social insurance hypothesis" is at variance with a number uncovered in the analysis below. First, mainly intrinsic religiosity is affected, to a lesser extent church going. In fact, church going is not affected significantly in the event study or the persistency study. Second, if social insurance was a major channel, we would have expected that storms also increase religiosity, which is not the case. Third, the study of children of immigrants documents an inter-generational spillover of the effect of earthquakes, which speaks for a cultural explanation. Fourth, the impact of earthquake risk is unaltered when controlling for actual earthquakes.

This research contributes to the understanding of the origins of differences in religiosity across societies. Societies located in earthquake areas have developed a culture of higher religiosity, which is passed on through generations. Further, if an exogenous deep determinant of religiosity exists, and is still at play today, this might help understand the fact that religiosity has not declined greatly with increased wealth and knowledge as the modernization hypothesis otherwise suggests.[16]

Other studies have investigated the impact of various shocks on religiosity. Ager & Ciccone (2014) show that American counties faced with higher rainfall variability saw higher rates of church membership in 1900. Their interpretation is that the church acts as an insurance against risk, making membership of religious organizations more attractive in high-risk environments. Even more related to the current study, Ager *et al.* (2014) show

[15] Rightly so, a proper investigation of the issue would be to compare immigrants' religiosity to the religiosity of the inhabitants of their country of origin. I have not found a way to do so.

[16] It is disputed whether religiosity has declined at all. Iannaccone (1998) notes that numerous analyses of cross-sectional data show that neither religious belief nor religious activity tends to decline with income, and that most rates tend to increase with education. However, Norris & Inglehart (2011) note that many of these studies are done within America, which seems to be a different case than the rest of the World, where they document a fall in religiosity.

that church membership increased in the aftermath of the 1927 Mississippi river flooding, also interpreting the result as social insurance. Other studies document effects of economic shocks on religiosity. Exploiting the fact that rice-growers suffered less than average during the Indonesian financial crisis, Chen (2010) finds that households who suffered more from the crisis were more religious.

This study relates more broadly to a growing literature within economics investigating the endogenous emergence of potentially useful beliefs. The literature has linked differences in gender roles to past agricultural practices (Alesina *et al.* (2013)), individualism to past trading strategies (Greif (1994)), trust to slave trades in Africa, historical literacy, institutions, and climatic risk (Nunn & Wantchekon (2011), Tabellini (2010), Durante (2010)), antisemitism to the Black Death and temperature shocks (Voigtländer & Voth (2012), Anderson *et al.* (2013)). The current study links a cultural value with evident implications for economic outcomes (religiosity) to one of its potential roots; disaster risk.

The paper is structured as follows. Section 2 reviews the literature on religious coping and sets up testable implications. Section 3 presents the data and documents the global impact of earthquakes on religiosity, validates the findings in relation to the religious coping literature, and documents a causal short term effect and a lasting long term impact across generations. Section 4 combines the results. Section 5 concludes.

2 Religious coping

This paper tests the religious coping hypothesis. That is, the proposition that people cope with adverse life events by relying on their religion. This tendency has been discovered within various fields from anthropological studies of indigenous societies to empirical analyses within sociology and psychology. I label this tendency "religious coping" in line with the psychology literature, noting that other terminologies have been invoked; religious buffering, the religious comfort hypothesis etc.[17] Religious coping is much in line with the hypothesis by Norris & Inglehart (2011) on existential security: people who experience existential insecurity tend to be far more religious than those who grow up under safer, comfortable, and more predictable conditions.

Coping in general is a process through which individuals try to understand and deal

[17] The uncertainty hypothesis also involves religious coping, but concerns more specifically the fact that religious coping is more profound in unpredictable situations, which I shall return to.

with significant personal and situational demands in their lives (e.g., Lazarus & Folkman (1984), Tyler (1978)). Religious coping involves drawing on religious beliefs and practices to understand and deal with these life stressors (Pargament (2001)).[18] Religious coping takes different forms: Obtaining a closer relation to God, praying, attempting to be less sinful, or searching for an explanation for the event; for example, tragedies can be interpreted as part of God's plan and/or a punishment from God (Pargament (2001)).

Perhaps the first to observe that the extent of religious activity (or rituals and magic) varies between different natural circumstances was Bronislaw Malinowski, one of the fathers of ethnography, who lived with the Trobriand islanders of New Guinea for several years around 1910 to study their culture (Malinowski (1948)). Rituals were crucial in the lives of all islanders, who were convinced that their agricultural yields benefitted just as much from rituals and magic as they did from hard work and knowledge. Malinowski observed a variation in the use of rituals, though. When going fishing inside the calm lagoon, the Trobriand islanders relied entirely on their fishing skills, but when fishing outside the lagoon in the dangerous, deep ocean, they engaged in various rituals. Malinowski interpreted the rituals as helping the islanders to cope with the stress involved with the unforeseen dangers of the open sea.[19]

Since Malinowski, numerous studies have found that people hit by severe adverse life events such as cancer, heart problems, other severe illnesses, death in close family, alcoholism, divorce, injury, threats, accidents etc. tend to engage in religious coping.[20] In fact many studies identify religious coping methods to be among the most common, if not the most common, ways of coping with stresses of various kinds.[21] Further corroborating the importance of religious coping, studies have found that religion does seem to help the victims by resulting in better physical functioning, less anxiety, better self-esteem, lower levels of depression, or other event-related distress (review by Smith *et al.* (2000)).[22] Most studies

[18] E.g., Pargament (2001), Cohen & Wills (1985), Park *et al.* (1990), Williams *et al.* (1991).

[19] Various studies have since then arrived at similar conclusions. Poggie Jr *et al.* (1976) asked fishermen to recall the number of ritual taboos practiced on a fishing trip and found that longer trips instigated more rituals than shorter trips, involving less risk. Steadman & Palmer (1995) interpret the rituals slightly differently; as a signal of willingness to cooperate.

[20] See e.g., Ano & Vasconcelles (2005), Pargament *et al.* (1990), and Smith *et al.* (2003) for reviews.

[21] See review by Pargament (2001). For instance, Bulman & Wortman (1977) studied the reactions of victims of severe spinal cord injuries, and found that the most common explanation for the event was to view it as part of God's plan, rather than for instance chance.

[22] See another review by Pargament (2001), who found that three-quarters of the studies on religion and health confirmed a relationship between religious coping and better health and wellbeing. Smith *et al.* (2003) reviews 147 studies on the impact of religiosity on depressive symptoms and find that religiosity is mildly associated with fewer symptoms. More recently, a medical study by Miller *et al.* (2014) shows

are performed on small samples, but Clark & Lelkes (2005) find that across various European countries, individuals with a religious denomination experience a lower reduction in wellbeing from unemployment or divorce than do those without a religious denomination.

Being hit by adverse life events is most likely correlated with unobserved individual characteristics (like lifestyle), which in turn may matter for the individual's inclination to be religious. Norenzayan & Hansen (2006) addressed this endogeneity problem by performing a controlled experiment of 28 undergraduate students from University of Michigan. They primed half of the students with thoughts of death by having them answer questions such as "What will happen to you when you die?" and the other half with neutral thoughts by having them instead answer questions such as "What is your favorite dish?" The students primed with thoughts of death were more likely to reveal beliefs in God and to rank themselves as being more religious after the experiment.

Another way of addressing the endogeneity problem is to analyze the impact of natural disasters on the degree of religious beliefs as done in the current study.[23,24] Indeed, the belief that natural disasters carried a deeper message from God, was the rule rather than the exception before the Enlightenment (e.g., Hall (1990), Van De Wetering (1982)). For instance, the famous 1755 Lisbon earthquake has been compared to the Holocaust as a catastrophe that transformed European culture and philosophy.[25]

Penick (1981) investigated more systematically reactions to the massive earthquakes in 1811 and early 1812 with epicenter in Missouri, USA. In the year after the earthquake, church membership increased by 50% in Midwestern and Southern states, where the earthquakes were felt most forcefully, compared to an increase of only 1% in the rest of the United States. Turning to more current examples, the Gallup survey after the US Midwest flooding in 1993 mentioned in the introduction illustrates the contemporary relevance. Smith *et al.* (2000) asked the victims of the same flooding about their religious coping in response to

that individuals who reported a higher importance of religion or spirituality had thicker cortices than those who reported moderate or low importance of religion or spirituality, meaning that the religious had a lower tendency for depression.

[23] I focus here exclusively on negative events. The religious coping literature broadly agrees that religion is mainly used to cope with negative events rather than positive. See for instance Pargament & Hahn (1986), Bjorck & Cohen (1993), Pargament *et al.* (1990), Smith *et al.* (2000).

[24] Other types of disasters are potentially relevant for religious coping. For the Maya and Inca "diseases were supposed to derive from crimes in the past - above all, theft, murder, adultery, and false testimony" (Hultkrantz (1979)). Fast forward in time, the Black Death that swept across Europe between 1347 and 1360 had a significant impact on religion, as many believed the plague was God's punishment for sinful ways (MacGregor (2011)).

[25] See review by Ray (2004). In addition to being one of the deadliest earthquakes ever, it also struck on an important church holiday and destroyed almost every important church in Lisbon.

the disaster. Many reported that religious stories, the fellowship of church members, and strength from God helped provide the support they needed to endure and survive the flood.[26] Even more recently, Sibley & Bulbulia (2012) analyze the reactions to the 2011 Christchurch earthquake. Religious conversion rates increased more in the affected region compared to the remaining four regions of New Zealand in the aftermath of the earthquake (likewise, fewer people abandoned their religion).

Elevated religiosity in the aftermath of disaster can be due to different types of religious coping. The 1993 Gallup survey, is an example where people interpret the disaster as a sign of God's anger, which provides them with stress relief: the World makes sense.[27] However, even if most people agree that tectonic plates, not God, cause earthquakes, they can still use their religion to cope with the stress and disorder felt after the disaster. By believing more, praying and/or going to church. Whichever religious coping mechanism is used, the outcome is the same and can be turned into a first testable prediction:

Testable implication 1: Disasters increase religiosity.

If we are to use the theory of religious coping to better understand global differences in religiosity, religious coping should not be something special about for instance Christianity. Indeed, there are reasons to believe that religious coping is a global phenomenon, pertaining not just to particular religious denominations. Pargament (2001) notes that (p3): "While different religions envision different solutions to problems, every religion offers a way to come to terms with tragedy, suffering, and the most significant issues in life." Likewise, Norris & Inglehart (2011) stress that virtually all of the World's major religions provide reassurance that, even though the individual alone cannot understand or predict what lies ahead, a higher power will ensure that things work out. Hence, in theory religious coping is for adherents to all religions. However, the empirical studies of religious coping include mainly samples of individuals from Christian societies. One study did attempt to distinguish between coping across different denominations: Gillard & Paton (1999) found that 89% of Christian respondents, 76% of Hindus, 63% of Muslims on Fiji responded that their respective beliefs were helpful after Hurricane Nigel in 1997.[28] Hence, rather high religious coping within

[26] Analysing a somewhat different disaster - the September 11 attack - Schuster *et al.* (2001) found that 90% of the surveyed Americans reported that they coped with their distress by turning to their religion.

[27] Apparently, humans have an evolved tendency to constantly search for reasons, and thus to interpret natural phenomena as happening for a reason rather than by chance alone (Guthrie (1995), Bering (2002)). From there, it seems a small step to assign the cause to some supernatural agency (Johnson (2005)).

[28] For further evidence expanding beyond Western socieites, see Pargament (2001) for a review, Tarakeshwar *et al.* (2003) for evidence of religious coping among Hindus, and MacGregor (2011) for evidence of relgious coping within Buddhism.

all three religious groups. This translates into a second prediction:

Testable implication 2: Religious coping is not specific to any denomination.

2.1 Differential uses of religious coping

Identifying a strong relation between disasters and religiosity obviously cannot in and by itself be interpreted as religious coping. It could be selection, omitted confounders or something else. While the event study in Section 3.5 addresses most of this, the religious coping hypothesis can be investigated further by testing additional predictions from the literature. These are outlined below.

2.1.1 Believing versus churchgoing

Religious coping seems to involve mainly elevated believing rather than churchgoing. Koenig *et al.* (1988) found that the most frequently mentioned coping strategies among 100 older adults dealing with three stressful events were trust and faith in God, prayer, and gaining help and strength from God. Social church-related activities were less commonly noted. Another indicator of whether religious coping is an efficient coping strategy is whether it leads to reduced stress. A medical study by Miller *et al.* (2014) shows that importance of religion reduces depression risk (measured by cortical thickness), while frequency of church attendance had no effect on the thickness of the cortices. These findings were corroborated by Koenig *et al.* (1998) who found that time to remission was reduced among 111 hospitalized individuals engaging in intrinsic religiosity, but not for those engaging in church going.

Testable implication 3. Disasters increase believing more than church going.

2.1.2 People with fewer resources

Individuals with fewer resources seem to engage in religious coping to a larger extent than those with abundant resources. The reasoning is that individuals use the coping strategies that are most available and compelling to them (Pargament (2001)).[29] Pargament stresses that those with limited means and few alternatives, will probably find religion in coping more attractive than other coping strategies, merely because of its relative availability. Praying

[29] Related to this, religion is more available to religious people, and not surprisingly, religious people engage more in religious coping than others (see review by Pargament (2001) and study by Pargament *et al.* (1990) and Wicks (1990).

to God most often demands no resources, while visiting a shrink can be rather resource demanding. Along the same lines, Norris & Inglehart (2011) argue that feelings of vulnerability to physical, societal, and personal risks are a key factor driving religiosity. They argue that the importance of religiosity persists most strongly among vulnerable populations, especially those living in poorer nations, facing personal survival-threatening risks.

Testable implication 4: Religious coping is stronger among those with few alternatives.

2.1.3 Unpredictability

Religious coping is more prevalent as a reaction to unpredictable/uncontrollable events, rather than predictable ones.[30] This idea is called the Uncertainty hypothesis and probably has its' roots in the beforementioned observation by Malinowski (1948). The reasoning is that religious coping belongs to emotion-focused coping, which aims at reducing or managing the emotional distress arriving with a situation, as opposed to problem-focused coping, which aims at doing something to alter the source of the stress.[31] A study of 1556 adults in Detroit coping with major life events or chronic difficulties found that religious coping was more common in dealing with illness and death than in dealing with practical and interpersonal problems (Mattlin *et al.* (1990)). Hood Jr (1977) asked high school students who were about to spend a solitary night in the woods to state how stressful they expected the night to be. The actual stressfulness of the night was determined by the weather; some nights it rained heavily and other nights were dry. Upon return, Hood found that religious mystical experiences were reported most often by students who anticipated a stressful night, but encountered no rain, and by the students who did not expect a stressful night, yet ran into a stormy evening.

It seems that the reaction to unpredictability extends into the animal world as well. Skinner (1948) found that pigeons who were subjected to an unpredictable feeding schedule developed superstitious ritual behavior, compared to the birds not subject to unpredictability. Since Skinner's pioneering work, various studies have documented how children and adults in analogous experimental conditions quickly generate novel superstitious practices (e.g., Ono (1987)).[32]

[30] E.g., Norris & Inglehart (2011), Sosis (2008), Park *et al.* (1990).

[31] Folkman & Lazarus (1985), Folkman & Lazarus (1980). In general, Carver *et al.* (1989) identifies five distinct aspects of emotion-focused coping: Turning to religion, seeking of emotional social support, positive reinterpretation, acceptance, and denial, and five distinct aspects of problem-focused coping: Active coping, planning, suppression of competing activities, restraint coping, and seeking instrumental social support.

[32] See Sosis (2008) for an overview.

Testable implication 5: Unpredictable stressful events increase religiosity more than predictable ones.

3 Empirical analysis

The purpose of the empirical analysis is to show first that religiosity is higher for individuals living in high-earthquake risk areas across the entire globe (the cross-district study in Section 3.4), second that the impact is causal: individuals *become* more religious in the aftermath of an earthquake (the event study in Section 3.5), and third that a long-run impact exists: earthquakes instigate a culture of religiosity, which can be traced across generations (the persistency study in Section 3.6). To validate the results vis-a-vis the religious coping literature, I investigate the testable implications from Section 2. Section 4 provides a simple overview of the main results combined.

3.1 Data on religiosity

The data on religiosity used in the main analysis (Sections 3.4 and 3.5) is the pooled World Values Survey (WVS) and European Values Study (EVS) carried out for 6 waves in the period 1981-2009.[33] This dataset includes information from interviews of 424,099 persons (representative of the general population in each country) residing in 96 countries.

In order to match the data from the pooled WVS-EVS with spatial data on natural disasters and other geographic confounders, I use the information on the subnational district in which each individual was interviewed. I match this with a shapefile containing first administrative districts of the World.[34] In this way, I was able to place 212,157 of the individuals in a subnational district from the ESRI shapefile. This means 914 districts in 85 countries out of the original 96 countries, covering most of the inhabited part of the World, depicted in Appendix Figure A1.[35]

[33] Available online at http://www.worldvaluessurvey.org and http://www.europeanvaluesstudy.eu. After the first revision of this paper, an additional wave has come out (2010-2014) for some of the religiosity measures. The new wave has not been incorporated into the main analysis, due to a) the cumbersome process of matching the subnational districts to a geographic shapefile must be done anew since the districts are different and b) some of the measures in the Strength of Religiosity Scale are not available in the new wave, which means that the results using the main religiosity measure, Strength of Religiosity Scale, will be unaltered. I do show country-aggregates using the new wave.

[34] The shapefile is freely available at ESRI.com.

[35] The number of districts in a country ranges from 2 to 41. The mean (median) number of districts per country is 15.9 (14).

The individuals in the pooled WVS-EVS were asked a multitude of questions concerning cultural values, including their religious beliefs. As my main measure of religiosity, I use the Strength of Religiosity Scale developed by Inglehart & Norris (2003). The six indicators that enter the measure are (when nothing else is indicated, these are dummy variables with 1="yes", 0="no"): (1) How important is God in your life? (0="not at all important",..., 10="very important"), (2) Do you get comfort and strength from religion?, (3) Do you believe in God?, (4) Are you a religious person? (1="convinced atheist", 2="not a religious person", 3="religious person"), (5) Do you believe in life after death?, and (6) How often do you attend religious services? (1="Never, practically never", ..., 7="More than once a week").[36] I rescaled all measures to lie between 0 and 1. Following Inglehart & Norris (2003), I rescaled answers to the question "Are you a religious person?" into a dummy variable with 1 indicating yes and 0 indicating no, as there are very few respondents answering that they are convinced atheists.[37] Following Inglehart & Norris (2003), I used factor component analysis to compress the six indicators into one measure, called $religiosity_{idct}$, for individual i living in subnational district d in country c, interviewed at time t.

The summary statistics for the 6 religiosity measures are summarized in Table 1 for the dataset used in the cross-sectional analysis in the first two columns where information on the subnational district is available, and for the full WVS-EVS dataset in the last two columns. The degree of religiosity is very similar in the two samples, speaking to the representativeness of the sample with information on the subnational district. We see that 84-87% of the respondents believe in God, 61-65% believe in life after death etc.

[36] The original variables were: (1): f063, (2): f064, (3): f050, (4): f034, (5): f051, and (6): f028.

[37] In addition, I changed the original categories for f028 about attendance at religious services, which originally ranged across 8 categories: More than once a week; once a week; once a month; only on special holy days/Christmas/Easter; other specific holy days; once a year; less often; never, practically never. I aggregated the two categories "only on special holy days/Christmas/Easter" and "other specific holy days", since there were very few observations in the latter and since it is not possible to rank the two.

Table 1. Summary statistics of Inglehart's (2003) 6 religiosity measures

	Data with district information		Full WVS-EVS dataset	
Measure	N	Mean	N	Mean
How important is God in your life?[a]	203,514	.728	398,938	.681
Do you find comfort in God?	130,384	.738	296,453	.689
Do you believe in God?	134,201	.868	303,240	.839
Are you a religious person?	197,137	.711	387,711	.703
Do you believe in life after death?	123,968	.645	281,146	.608
How often do you attend religious services?[a]	201,674	.492	401,593	.464

Notes. The unit is an individual. All variables, except those marked with an a, are indicator variables. The two first columns show summary statistics for the dataset where information on the subnational district in which the individual was interviewed is available. The two last columns show the entire pooled WVS-EVS 1981-2009 dataset. Source: pooled EVS-WVS 1981-2009 dataset.

The average (median) district has 766 (466) respondents in total, or 335 (235) respondents per year of interview.[38]

The data on religiosity used in the persistency study is described in Section 3.6.

3.2 Data on long term earthquake risk

The main measure of earthquake risk in the cross-district study (Section 3.4) and the persistency study (Section 3.6) is based on data on earthquake zones, provided by the United Nations Environmental Programme as part of the Global Resource Information Database (UNEP/GRID) and depicted in Figure 1.[39,40] Earthquake risk is divided into 5 categories, 0-4, based on various parameters such as ground acceleration, duration of earthquakes, subsoil effects, and historical earthquake reports. The intensity is measured on the Modified Mercalli (MM) Scale and the zones indicate the probability that an earthquake of a certain size hits within 50 years. Zone zero indicates earthquakes of size Moderate or less (V or below on the MM Scale), zone one indicates Strong earthquakes (VI on the MM Scale), zone

[38] Throughout, only districts with more than 10 respondents in each year are included in the estimations. This means dropping 9 districts in the main regressions of Table 2. Including the full set of districts does not alter the results, neither does restricting the required number of respondents further, and neither does weighting the results with the number of respondents, see Appendix B.2.

[39] Data available online at http://geodata.grid.unep.ch/.

[40] Data on for instance losses from natural disasters is inappropriate for the current analysis, as losses are highly endogenous to economic development, which in itself might correlate with religiosity.

two indicates Very Strong (VII), three indicates Extreme (VIII), zone four indicates that a Violent or Severe earthquake will hit (IX or X).

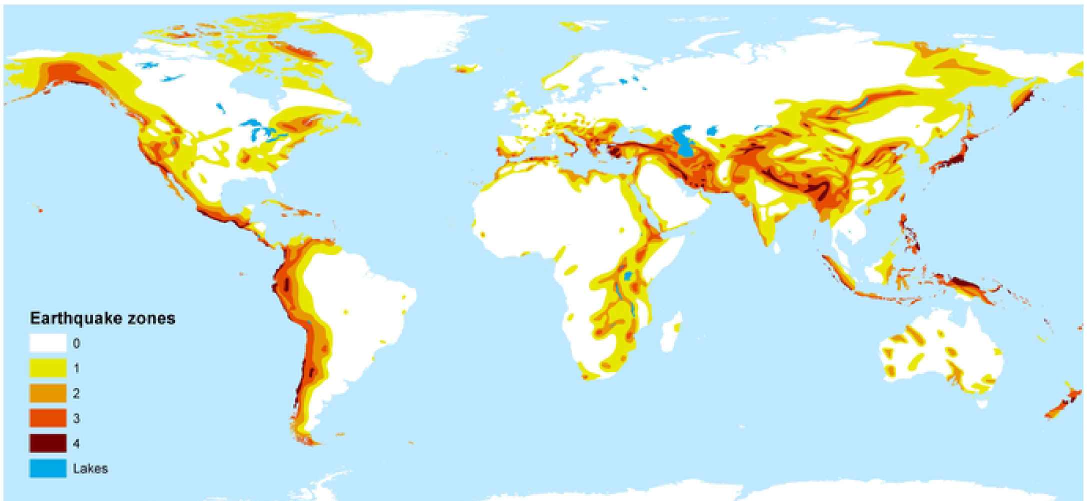


Figure 1. Earthquake zones

Notes. Darker color indicates higher earthquake risk. The main measure of long-term earthquake risk measures the distance from district centroid to zones 3 or 4. Source: UNEP/GRID

To calculate earthquake risk for subnational regions of the World, I use ArcGIS software combining the shapefile of first administrative units from ESRI.com with the raster data pictured in Figure 2. I construct the variable $dist(earthquakes)_{dc}$ as the geodesic distance from the centroid of subnational district d located in country c to the closest high-intensity earthquake zone, where the choice of which zones to classify as high intensity is a weighing between choosing zones that are represented in as many parts of the World as possible and choosing zones where the particular level of earthquake risk may potentially matter for peoples' lives. Appendix B.3 shows that the main results (of Table 2 below) hold for all choices of zones: distance to zones 1-4, zones 2-4, zones 3-4, and zone 4 only. The appendix shows that the relation between religiosity and $dist(earthquakes)$ increases in size when adding more zones, but the precision also diminishes. In an attempt to maximize precision and relevance at the same time, I define the two top earthquake zones (3 and 4) as "high intensity" zones in the main results. That is, $dist(earthquakes)_{dc}$ measures the distance from the district centroid to zones 3 or 4 (dark red and dark orange on the map).

Another measure of earthquake risk is the average earthquake zone value in a district, $mean(earthquake)_{dc}$. Appendix B.3 shows that the main conclusion is unaltered when using instead this measure. The correlation between $mean(earthquake)$ and $dist(earthquakes)$ is high: -0.65. However, $dist(earthquakes)$ wins the horse race between the two when included simultaneously in the main regression on religiosity, shown in Appendix B.3. The reason for the superiority of the distance measure is essentially that some information is lost when using the mean measure. According to the $mean(earthquake)_{dc}$ measure, a district located entirely in earthquake zone zero, but neighboring a district that is hit frequently by earthquakes, will obtain the same earthquake risk score as another zero zone district located, say, 2000 km from any high-intensity earthquake zone. The inhabitants of the former are obviously more aware of earthquakes and perhaps even have family members in high-frequency zones, while earthquakes probably play no role whatsoever for the lives of the inhabitants of the district located 2000 km away. Therefore, the distance measure provides a more accurate measure of the presence of the stress caused by earthquakes in peoples' lives compared to an average measure.

Another benefit from calculating distances is that various disaster measures can be more easily compared. For instance, the earthquake risk data is based on zones, while the tsunami data is based on instances of tsunamis. It is not clear how to construct a mean measure for the latter. While the main disaster frequency measure is based on earthquakes, additional disasters are investigated in Table 3.

Based on the distance measure, the region with the lowest earthquake risk in the sample is the region of Paraíba, a region on the Eastern tip of Brazil, located 3,355 km from the nearest high-intensity earthquake zone (the earthquake zone located on the Westcoast of South America). Many regions obtain an earthquake distance of zero as they are located within earthquake zones 3 or 4.[41] Examples are Sofia in Bulgaria, the Kanto region of Japan, and Jawa Tengah in Indonesia. The mean (median) distance to earthquake zones 3 or 4 is 441 (260) km.

3.3 Data on earthquake events

The data on earthquake events, used as control variables in the cross-district study and as main earthquake variable in the event study, is based on the Advanced National Seismic System (ANSS) at the US Geological Survey (USGS). USGS provides data on the timing,

[41] For robustness, Appendix B.6 excludes the zeroes with no change to the results, indicating that the estimated effect of earthquakes on religiosity can be interpreted as the impact of earthquakes on units that are located close to an earthquake zone, but are not necesarily devastated by earthquakes.

location and severity of all earthquakes that happened since year 1898.[42] I include events that are described as moderate, strong, major or great and exclude everything defined as micro, minor or light, and restrict myself to earthquakes that happened over the timeframe of the pooled WVS-EVS: 1981-2009.[43] These earthquakes are depicted in Figure 2. The figure also depicts the districts included in the analysis, where the dark green districts are those included only in the within-district analysis (those with data for more than one year) and the sum of the dark and light green are the districts entering the cross-districts analysis.

I construct a measure of earthquake events for each subnational district in two steps. First, for each of the subnational districts I calculate the distance to the nearest earthquake. I do this for every year from 1981 to 2009.

Second, I then define a district as being hit by an earthquake if the earthquake hit within X km of the district. I choose X low enough to ensure that the earthquake was likely to influence the people in the particular district, but high enough so as to ensure that I have enough earthquakes in my sample. The main variables used below use a cutoff of 100 km. Hence, when an earthquake hit within 100 km of the district centroid, I define the district as being hit by an earthquake. Note that for most districts, this means that the earthquake hit within the district borders. Appendix C.1 shows that the main results in Section 3.5 are robust to alternative cutoff levels.

[42] Available online: http://earthquake.usgs.gov/monitoring/anss/

[43] This corresponds to earthquakes of a strength above 5.0 on the Richter scale. I am interested in the distance to an earthquake of a certain size and therefore including the smaller earthquakes would introduce noise into the estimates. The assumption is here that earthquakes categorized as micro, minor or light do not trigger religious coping. Comparing to the earthquake zones in Figure 1, zones 3-4 correspond to above 6.0 on the Richter scale. As the cross-district analysis uses the distance to these zones, it implicitly also includes the smaller earthquakes, as we move further away from the high-risk zones.

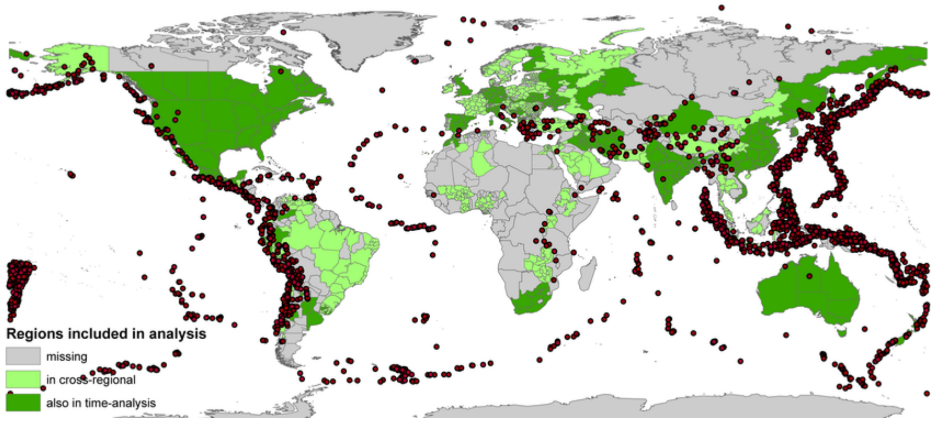


Figure 2. Districts and earthquake events

Notes. Map of subnational districts from the pooled WVS/EVS 1981-2009 and the epicenter of all earthquake events of a strength above five on the Richter Scale that happened over the period 1981-2009. Dark green districts are measured more than once, while light green indicates that the district is measured once. Source for earthquake data: USGS.

3.4 Cross-districts study

In order to test whether individuals are more religious when living in areas hit more frequently by earthquakes, I estimate equations of the form:[44]

$$religiosity_{idct} = \alpha + \beta earthquakerisk_{dc} + \gamma_c + \lambda_t + X'_{dct}\eta + W'_{idct}\delta + \varepsilon_{idct}, \qquad (1)$$

where $religiosity_{idct}$ is the level of religiosity of individual i interviewed in subnational district d within country c at time t, $earthquakerisk_{dc}$ is earthquake frequency in district d of country c. γ_c measures country-fixed effects, removing variation in nationwide factors (e.g., some dimensions of culture and institutions). λ_t measures year of interview fixed effects. W_{idct} is a vector of relevant controls at the individual level: age, age squared, sex, marital status, education, income.

X_{dct} captures observable district-level confounders: dummies to weed out the short term effects of actual earthquakes, distance to the ocean, and other geographic confounders potentially related to earthquakes, described below.

Table 2 shows the results from estimating equation (1) across 105,947 individuals from 591 subnational districts of the world, using distance to nearest high intensity earthquake

[44] I use the appropriate weights provided by the pooled WVS/EVS (original country weights, variable s017). The estimates are very similar when not using weights.

zone, $dist(earthquakes)$, as the measure of earthquake risk.[45] The religiosity measure is the Strength of Religiosity Scale in columns (1)-(5).[46] The first column shows the simple relation between religiosity and distance to earthquakes. The estimate on earthquake distance is highly significant and of the expected sign: individuals living in districts that are located closer to an earthquake zone, are more religious.

One may worry that natural disasters correlate with countrywide factors, such as geography or some dimensions of culture and institutions, which also have a bearing on religiosity. To accommodate this, column (2) includes country fixed effects. The estimate on earthquake-distance drops by only a quarter, indicating that the main impact from earthquakes on religiosity seems to work within countries. The sample includes interviews of individuals surveyed in 19 different years between 1981 and 2009. While the earthquake measure here does not vary over time, it could still be the case that the timing of the measure of religiosity biases the results. Column (3) adds time-fixed effects with no change to the results.

Column (4) adds individual-level standard controls for sex, marital status, age, and age squared. The estimate on earthquake distance drops slightly in absolute size, but not significantly.

Column (5) includes district-level geographic controls to account for various concerns. First, one may worry that the impact of $earthquakerisk_{dc}$ captures a short term effect of actual earthquakes that hit the district recently. Or opposite; the long-term impact could be contaminated by recent earthquakes.[47] Therefore, column (5) adds a dummy equal to one if an earthquake hit in the current year of interview and a dummy equal to one if an earthquake hit in the year before the interview.[48] Second, since a large part of the severe earthquake zones are located close to the ocean, one may worry that $\hat{\beta}$ is contaminated by some correlation between distance to the ocean and religiosity. Therefore, distance to the

[45] The Table includes only answers to questions answerred by at least 10 individuals within a district. Appendix B.2 shows that results are robust to other cutoffs. dist(earthquake) measures the distance from the district centroid to earthquake zones 3 or 4. Appendix B.3 shows that the results are robust to choosing other zones and Appendix B.4 shows that the distance measure is better than a measure of means across zones. Appendix B.7 shows that results are robust to other functional forms, such as including a squared term of earthquake distance, using instead (1+) the logarithm of the earthquake distance, etc.

[46] Appendix B.9 shows that the distance to earthquakes predicts each of the different components of the Strength of Religiosity Scale. Furthermore, one particular component of the Strength of Religiosity Scale with the most answers, namely answers to the question "How important is God in your life?" is included in most other robustness checks in addition to the Strength of Religiosity Scale.

[47] Corroborating this, Appendix B.5 shows that the impact of long term earthquake risk is reduced when a recent earthquake hit.

[48] Appendix B.5 shows that adding more lags does not change the results.

ocean is also included in column (5). Third, larger districts may be hit by more earthquakes, which is the reason for including a control for district area. Last, absolute latitude is added as a "catch-all" geographic measure. The estimate on distance to nearest earthquake zone is unaltered when including these controls.

The remaining part of the analysis will include all the exogenous controls from column (5) of Table 2. Additional controls (trust, population density, light density at night, arable land shares, temperature average, precipitation average and variance) are included in Appendix B.6 with no change to the results. Indeed, the estimate of interest stays remarkably constant throughout the inclusion of the additional controls. In fact, the variable resulting in the largest reduction in the estimate of earthquake distance on religiosity, $\hat{\beta}$, is arable land, which reduces $\hat{\beta}$ from 0.061 to 0.058. If any omitted variable should reduce $\hat{\beta}$ to be statistically indistinguishable from zero, it should result in a ten times larger reduction compared to the reduction caused by arable land.[49] Nevertheless, Section 3.5 performs diff-in-diff analysis to exclude any omitted factors at the district-level.

Table 2. OLS of religiosity on long-term earthquake risk

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable: Strength of Religiosity Scale [0;1]						
Dist(earthq), 1000km	-0.094***	-0.070***	-0.071***	-0.066***	-0.061***	-0.056***
	(0.023)	(0.017)	(0.017)	(0.017)	(0.016)	(0.015)
	[0.053]	[0.019]	[0.019]	[0.020]	[0.015]	[0.014]
Observations	105,947	105,947	105,947	103,283	103,281	66,112
R-squared	0.021	0.294	0.299	0.331	0.332	0.311
Country FE	N	Y	Y	Y	Y	Y
Year FE	N	N	Y	Y	Y	Y
Indl controls	N	N	N	Y	Y	Y
Geo controls	N	N	N	N	Y	Y
Inc and edu FE	N	N	N	N	N	Y
Districts	591	591	591	591	591	458
Countries	66	66	66	66	66	52

Notes. OLS estimates. The unit of analysis is an individual. The dependent variable is Inglehart's Strength of Religiosity Scale [0,1], which is an average (principal components analysis) of answers to six questions on religiosity, depicted in Table 1. Dist(earthquake) measures the distance in 1000 km from the district centroid to the nearest high-intensity earthquake-zone (zones 3 or 4), depicted in Figure 1. Country FE indicates country fixed effects, time FE indicates year of interview fixed effects. Indl controls indicates controls for respondent's

[49] This exercise reduces the estimate on disaster distance to 0.031, which is not statistically different from zero at the 5 percent level.

age, age squared, sex, and marital status. Geo controls indicates subnational district level controls for absolute latitude, distance to the coast, district area, and earthquake dummies for whether an earthquake hit in the year of interview or the year before. Inc and edu FE indicates 10 income dummies and 8 education dummies. Districts indicates the number of subnational districts in the sample. Likewise, countries refers to the number of countries. The standard errors are clustered at the level of subnational districts in parenthesis and at the country-level in squared brackets. All columns include a constant. Asterisks ***, **, and * indicate significance at the 1, 5, and 10% level.

According to the modernization hypothesis (e.g., Inglehart & Baker (2000)), income and education levels may influence an individual's degree of believing, which poses a potential problem if earthquakes influence income and education levels. So far, the literature has been inconclusive as to the effect of earthquakes on economic outcomes (see e.g., Ahlerup (2013) for a positive effect, Cavallo *et al.* (2013) for a negative impact), perhaps because earthquakes have local effects that cancel each other out (e.g., Fisker (2012)). Nevertheless, to account for this, column (6) adds dummies indicating individuals' education and income levels based on the ordered categorical variables constructed by the WVS and EVS; income is measured in 1-10 deciles, while education ranges from 1-8, where 1 indicates "Inadequately completed elementary education" and 8 indicates "University with degree / Higher education".[50] Obviously, education and income are potentially endogenous to religiosity; perhaps more religious individuals are more hard working, trusting etc. and thus able to earn higher incomes, as shown by e.g., Guiso *et al.* (2003). Thus, the result in column (6) should be interpreted with caution.[51]

The distance to nearest earthquake zone ranges from 0 to 3,355 km. Even if the religious coping hypothesis was true, we do not expect that regions located 3,000 km from an earthquake zone are significantly more religious than regions located 3,100 km away. Both of these districts are located so far away from earthquake zones that 100 km should not matter much. In other words, the effect is probably not perfectly linear. Appendix B.7 confirms that the effect of earthquakes is stronger, when excluding districts located more than 1500, 1000, and 500 km away, or more formally; the squared term is significant and positive.[52] Appendix

[50]The estimate of interest is unchanged if the two categorical variables were included directly instead of the 18 dummy variables.

[51]A previous version of the paper further includes lights visible from space as another control for economic activity, also with no change to the results.

[52]When investigating the functional form, the number of observations becomes crucial. In fact, the non-linear relation is much stronger when using the religiosity measure with most observations, answers to the question "How important is God in your life?" The squared term is insignificant when using the Strength of

B.7 also shows binned scatterplots where the distance to nearest high-risk earthquake zone is divided into 50 equally-sized bins, revealing that the relation between earthquake distance and religiosity is stronger among districts located closer to the high-risk zones.

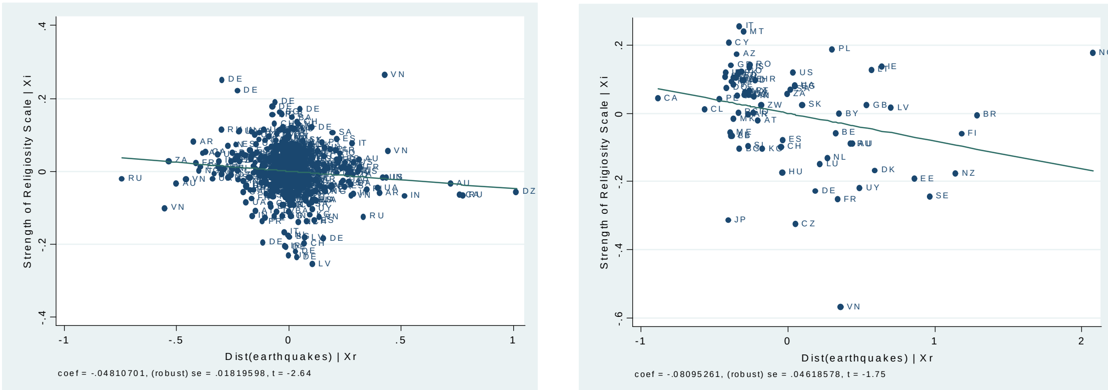
The main estimated standard errors in Table 2 are clustered at the subnational district level to account for potential spatial dependence. Clustering at the country-level produces the same conclusions, shown in squared brackets in Table 2. Another, more conservative, way to account for spatial dependence at the district (country) level is to average religiosity across districts (countries). The added variable plots in Figure 3 correspond to column (5) of Table 2 (exogenous baseline controls included), aggregated to the subnational district (country) level in the left (right) panel.[53] Whichever method is used, the estimate remains significantly different from zero.

The added variable plot further confirms that the result does not seem to be driven by individual observations. Furthermore, the cross-country estimates in the right panel also serve as an out-of-sample check of the results, since the country-level aggregates are independent of the information on subnational districts (which is only available for a subsample). This means increasing the number of countries included from 66 to 75.[54]

Religiosity Scale, available for fewer districts.

[53] The individual level confounders are controlled for before collapsing the residuals to the regional (country) level and the remaining confounders are accounted for in the aggregated sample. District level results for all columns of Table 2 are shown in a previous version of the paper, confirming the results.

[54] Furthermore, since the first version of this paper, a new wave of the World Values Survey has been published including interviews for years 2010-2014. As the merging of subnational regions is a rather cumbersome process, I have not updated the subnational results to include this new wave. Furthermore, not all religiosity questions included in the Religiosity Scale were asked in years 2010-2014, meaning that the Religiosity Scale measure would be completely unchanged. However, the Importance of God question was asked in the new wave. The AV-plot in Appendix B.8 includes the new wave for the Importance of God question, increasing the number of countries even further.



District aggregates Country aggregates

Figure 3. Added variable plots of religiosity on earthquake frequency

Notes. AV-plots of OLS estimation across district-level aggregates in the left panel and country level aggregates in the right panel. The dependent variable is the Strength of Religiosity Scale. Included controls correspond to those used in column (5) of Table 2, where the individual-level controls are accounted for before aggregation. Labels: Country ISO codes.

The AV-plots also reveal that the impact of earthquake risk on religiosity seems to be a global phenomenon. Appendix B.10, interacts earthquake risk with a dummy for each of the large religious denominations; Protestantism, Catholicism, Islam, Hinduism, and Buddhism in Table A10 and with a dummy for each continent in Table A11. Adherents to all religions engage in religious coping, although some engage a bit less (Catholics and Buddhists), others more (Protestants).[55] Furthermore, it does not matter for the degree of religious coping on which continent the individuals live. This confirms testable implication 2.

Getting at the size of the effect, taking the preferred estimate in column (5) at face value, individuals living in districts located 1000 km closer to a disaster-zone tend to be 6 pct points more religious. The median individual has a level of religiosity of 84% and lives in a district located 260 km from a high intensity earthquake zone. Increasing this distance by 500 km brings the region to the 80^{th} percentile in the disaster-distance distribution, and according to the estimation of column (5), reduces the religiosity from the 50^{th} to the 41^{st} percentile. Thus, reducing long-term earthquake risk 30 percentiles, reduces religiosity by 9 percentiles. This seems both economically significant and still plausible.

The results are robust to using the individual measures of religiosity entering the Strength of Religiosity measure one by one, shown in Appendix B.9. All six measures are significantly

[55] The finding that Protestants use religion in coping more than Catholics is consistent with the idea that Catholicism is a much more community based, while Calvin's doctrine of salvation is based on the principle of "faith alone" (Weber (1930), p.117). This gives the Catholics an alternative to intensified believing, namely their networks. There are not enough Buddhists and Hindus in the sample to properly test for their differential religious coping strategies.

higher in districts located near high-risk earthquake zones. In fact, the impact on answers to the question "Do you believe in an Afterlife?" is double as large as the impact shown in Table 2. Consistent with the literature on religious coping, churchgoing is less affected than believing, thus confirming testable implication 3. The exercise also serves as an increase in the sample size. Answers to the question "How important is God in your life?" is available for individuals from 884 districts, spanning 85 countries, compared to the 591 districts in Table 2. The impact is unaltered on this much larger sample.

One would expect that educated individuals are less likely to attribute earthquakes to acts of God. This is confirmed in Appendix B.12, which shows that highly educated individuals do use their religion in coping, but to a lesser extent than individuals with lower education levels. Furthermore, unemployed individuals engage more in religious coping, while married people less. These results confirm testable implication 4: unemployed and uneducated individuals have potentially fewer alternative coping strategies, making religious coping more appealing. Married people possess an additional coping strategy compared to singles, namely talking to their partner about their distress, reducing the need for religion in coping.

All in all the results corroborate the findings from the religious coping literature. Testable implication 5 is investigated below.

3.4.1 Alternative types of natural disasters

The literature on religious coping states that unforeseeable life events are more likely to instigate religious coping compared to more foreseeable adverse life events. Accordingly, we would expect that people use their religion to cope with unforeseeable disasters, such as earthquakes, tsunamis, and volcanoes, to a larger extent than more foreseeable disasters, such as seasonal storms.

Table 3 shows the impact on religiosity of distance to earthquakes, tsunamis, volcanoes and tropical storms.[56] All columns include the full set of exogenous baseline controls. Column (1) reproduces the regression using earthquakes. Tsunamis are included in column (2), exerting virtually the same impact on religiosity as earthquakes. Column (3) includes the average distance to earthquakes and tsunamis: $\frac{distance(earthquakes)+distance(tsunamis)}{2}$, whereas column (4) includes the minimum distance to either of the two: $min(distance(earthquakes), distance(tsunamis))$.

[56] The types of disasters are chosen based on the Munich Re map, which shows the worst types of disasters across the globe. The correlation between distance to earthquake zones and the other measures are: 0.457 (volcanoes), 0.381 (tsunamis), and 0.196 (storms), respectively. All disasters are described in Appendix B.11.

As expected, people are affected more if they live in area hit by both tsunamis and earthquakes, compared to an area hit by only one of the two.

In column (5), the disaster measure is distance to volcanoes, which is also a highly unforeseeable disaster. While the sign of the estimate is still negative, it is not significantly different from zero. It seems that volcanic eruptions simply hit too few districts of the World in order to have an impact: The size of the estimate increases nearly fivefold when zooming in on districts located within 1000 km of a volcanic eruption zone, becoming statistically different from zero.

A rather foreseeable type of disaster is tropical storms, included in columns (7) and (8). In accordance with the religious coping hypothesis, the impact of storms on religiosity is indistinguishable from zero and unchanged after zooming in on districts located within 1000 km of a storm zone.

Table 3. Varying disaster measures

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable: Strength of Religiosity Scale								
dist(disaster)	-0.061***	-0.058***	-0.086***	-0.076***	-0.008	-0.036***	-0.020	0.015
	(0.016)	(0.016)	(0.020)	(0.019)	(0.007)	(0.013)	(0.013)	(0.027)
Observations	103,281	103,281	103,281	103,281	103,281	58,567	103,281	38,568
R-squared	0.332	0.332	0.333	0.333	0.332	0.329	0.332	0.337
Disaster	Earthq	Tsunami	Avg	Min	Volcano	Volcano	Storm	Storm
Baseline controls	Y	Y	Y	Y	Y	Y	Y	Y
Sample	Full	Full	Full	Full	Full	<1000 km	Full	<1000 km
Districts	591	591	591	591	591	321	591	129

Notes. OLS estimates. The unit of analysis is an individual. The dependent variable is the Strength of Religiosity Scale [0,1]. The disaster measure is distance from district centroid to earthquake zones 3 or 4 in column (1), distance to tsunamis in column (2), the average distance to earthquake zones and tsunamis in column (3), the minimum distance to either earthquake zones or tsunamis in column (4), distance to volcano zones in columns (5) and (6), and distance to tropical storm zones in column (7) and (8). The following baseline controls are included in all columns: Country - and year fixed effects, controls for respondent's age, age squared, sex, and marital status, subnational district level controls for absolute latitude, distance to the coast, district area, and earthquake dummies for whether an earthquake hit in the year of interview or the year before. All columns include a constant. Standard errors are clustered at the level of subnational districts, in parenthesis. Asterisks ***, **, and * indicate significance at the 1, 5, and 10% level.

The results are consistent with testable implication 5: Religious coping is more profound as a response to unpredictable disasters as opposed to predictable disasters.

3.5 Event study

The results so far may be biased by unobservables at the district level. This section attempts to deal with this by estimating whether religiosity in a district changes when the district is hit by an earthquake. The same individuals are not observed at different points in time in the pooled WVS-EVS. But a third of the subnational districts from the cross-district analysis are measured more than once, which makes it possible to construct a so-called synthetic panel, where the panel dimension is the subnational district and the time dimension is the year of interview.[57]

For each year of interview, I aggregate religiosity to the district level, account for district-level fixed effects by first differencing a district-level version of equation (1), and last allow for country-by-year fixed effects arriving at:[58]

$$\Delta religiosity^{W}_{dct} = \alpha + \beta \Delta earthquake_{dct} + \lambda_{ct} + \Delta X'_{dct}\delta + \Delta\varepsilon_{dct}, \tag{2}$$

where $\Delta religiosity^{W}_{dct} = religiosity^{W}_{dct} - religiosity^{W}_{dct-1}$ measures the change in religiosity between waves t-1 and t of the pooled WVS-EVS in district d.[59] W indicates whether the same individual-level controls as in the cross-sectional analysis, W'_{idct}, are accounted for before aggregating the data: sex, marital status, age, age squared, 10 income dummies, and 8 education dummies.[60] The main measure of religiosity is answers to "How important is God in your life?", since this measure spans answers across most districts.[61] Using instead the Strength of Religiosity Scale produces the same results, although the level of significance is slightly lower due to smaller sample size, shown in Appendix C.2. Results for all religiosity measures are shown in Appendix C.4.

The data used to measure earthquakes is that described in Section 3.3, where an earth-

[57] 339 districts out of the 887 total districts were surveyed more than once. Restricting the sample of column (5) Table 2 to the sample, where districts were surveyed more than once does not alter the estimate on earthquake risk: -0.067 (se 0.018).

[58] An alternative model could include lagged religiosity, which means loosing many observations, but the conclusions are the same.

[59] $religiosity_{dct}$ is based on information at the individual level aggregated up to the district level, using appropriate weights, w_{idct}: $religiosity_{dct} = \frac{1}{N}\sum_{i=1}^{N} w_{idct} \cdot religiosity_{idct}$. The weights are the same weights as those used in the cross-district analysis above.

[60] In these cases, $religiosity^{W}_{dct}$ is the district-level aggregate of the residuals of a regression of $religiosity_{idct}$ on sex, marital status, age, age squared, 10 income dummies, and 8 education dummies. Another way to account for the individual level controls would be to first aggregate them to the district-level and include them in equation (2), but this would mean throwing away information.

[61] Focusing the analysis on intrinsic religiosity, and not church going, further makes sure that the mechanism is not social insurance.

quake is said to hit the district if the earthquake hit within 100 km of the district centroid. For each district, I count the number of earthquakes that hit in between interview waves. For X=100 km, the main cutoff used in the analysis, there were 302 district-year earthquake events, covering 89 districts. $\Delta earthquake_{dct} = earthquake_{dct} - earthquake_{dct-1}$ measures the number of earthquakes that hit in between the t-1 and t waves of the WVS/EVS. To make sure that the results are not driven by extremes, I throw away the 18 districts that experienced more than one earthquake in between waves, and thus $\Delta earthquake_{dct}$ becomes a dummy variable equal to one if an earthquake hit in between waves and zero otherwise. Appendix C.3 shows that the results are unchanged when including all districts.

λ_{ct} are country-by-year fixed effects indicating that everything at the country-level, which changes over time, is removed from the analysis.[62] Furthermore, since we are looking at first differences, everything at the district level which does not change over time (such as geographic characteristics, some cultural attributes, and some institutions) is accounted for.

$\Delta X'_{dct}$ includes two main district-level controls that change over time. First, the panel is highly unbalanced. For instance, Albania is divided into 4 districts, which are interviewed in year 1998 and year 2002, while Australia has 7 districts measured in year 1995 and year 2005. If religiosity reverts back to the long term level when stress relief has been obtained, we would expect that the impact of an earthquake on religiosity in societies like Albania with a shorter window of observation is higher than the impact for societies like Australia with a longer window of observation. For this reason, period length is controlled for. Furthermore, a main robustness check of the results includes an interaction term between earthquake and the period length (Appendix C.4 and C.3). Second, along the same line of reasoning, we would expect that an earthquake that hit 10 years ago would exert a smaller impact on current religiosity levels compared to an earthquake that hit last year. For this reason, I include a control for the number of years since an earthquake hit the district. For districts that did not experience an earthquake since 1981, I code this variable to 100.

The parameter of interest is β, which measures the difference in religiosity between districts that experienced an earthquake since the last interview and those that did not. The religious coping theory suggests that $\beta > 0$: religiosity is higher in districts that experienced an earthquake compared to those that did not.

[62] Results are unaltered if including instead country and time fixed effects separately.

3.5.1 Summary statistics

306 districts located within 37 countries have answers to the question "How important is God in your life?" for more than one year between 1981 and 2009. The number of years with data on religiosity per district ranges from 2 to 5 years, meaning that the average district is measured 2.5 times. The number of years in between interviews varies between 2 and 17 years across districts, meaning that religiosity is measured on average every 3.2 years.

34 districts experienced one or more earthquakes in between two WVS-EVS waves, totalling 49 earthquakes in the sample. The three districts that experienced most earthquakes (3) in between two interview waves were Kerman and Markasi in Iran and Kanto in Japan. Note that this depends both on the number of years in between interviews and the frequency of earthquakes in the district.[63] 7 other districts experienced more than one earthquake in between interviews. 26 districts experienced one earthquake. Table 4 summarizes the data.

Table 4. Summary statistics of the main variables for diff-in-diff

Measure	N	Mean	std.dev	Min	Max
$religiosity$	732	0.664	0.236	0	1
$\Delta religiosity$	413	0.017	0.123	-0.581	0.407
$\Delta earthquake$	413	0.119	0.427	0	3
Earthquake dummy	403	0.065	0.246	0	1
λ_t	732	2001.5	6.063	1981	2009
$\Delta\lambda_t$	413	6.552	3.200	2	17
For earthquake events					
# earthquake instances	49	1.361	0.639	1	3
# years since last earthquake	36	3.833	1.935	2	9

Notes. The unit of observation is a subnational district at time t. The religiosity measure is the district average of answers to the question "How important is God in your life?" (categorical variable with 10 possible answers from 0="not at all important" to 1="very important").

The WVS data does not provide information on the month in which the interview was conducted for a large enough share of the sample, and thus it is not possible to distinguish whether an earthquake striking in the year of the interview hit before or after the interview. I

[63] To account for this, Appendix Tables A15 and A17 includes interaction terms with the number of years in between interviews.

therefore drop observations where an earthquake hit in the same year as the WVS interview. This means dropping 15 observations in the main regressions.[64] Conclusions are unaltered if the 15 observations were included throughout.

3.5.2 Analysis

As an introductory exercise, Figure 4 splits the sample in two: districts hit by an earthquake and those that were not.[65] The figure shows that religiosity increased by 3.2 percentage points across periods in districts that were hit by an earthquake compared to a fall of 0.1 percentage points in districts that were not shaken by earthquakes.[66] The difference between the two averages is only nearly half a standard error, though, and more formal analysis is necessary to investigate whether the difference is statistically different from zero.

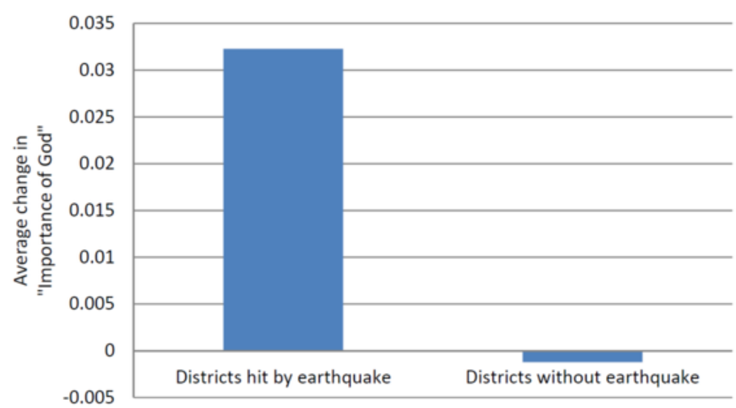


Figure 4. Change in religiosity by earthquake or not

Notes. Districts are split into the 24 districts that experienced an earthquake in between the survey years, and the 281 that did not. The sample is here restricted to districts, where the interview took place between 3 and 10 years apart.

Table 5 presents the results from estimating equation (2).[67] Column (1) shows the simple difference in religiosity between districts that were hit by an earthquake and those that were

[64] The WVS provides information on the month of the interview for a third of the sample. Hence, if I calculated instead the distance to the nearest earthquake in each month of each year, I could gain a maximum of 5 observations (a third times the 15 observations where an earthquake hit in the interview year), provided that none of the earthquakes hit in the same month as the interview.

[65] The number of years in between waves varies greatly from 2 to 17. In the main analysis, I control for the period length to account for this. In Figure 5, I instead throw away the top and bottom 10% of the period lengths, leaving a sample of districts measured with 3 to 10 years in between waves.

[66] Using instead the Strength of Religiosity Scale also produces the expected difference, though the numbers are a bit different. The average change in religiosity has been equal to 0.002 in the 149 districts hit by earthquakes and -0.01 in the 19 districts that were not hit by earthquakes.

[67] Standard errors are clustered at the country-level throughout. Conclusions are unaltered if using instead unclustered standard errors.

not, controlling only for country-by-year fixed effects. In line with the religious coping hypothesis, religiosity has increased more in districts that were hit, compared to those that were not. Column (2) adds a control for the number of years in between the interview years, since a longer period may both produce a larger change in religiosity and a larger likelihood that an earthquake has hit. And a control for the number of years since the last earthquake, set to 100 if no earthquake hit since 1981. The difference in religiosity between districts hit by an earthquake and those that were not hit is statistically unaltered, if anything it increases. Column (3) adds individual level controls and column (4) further adds income and education dummies.[68] The religiosity difference between districts hit by earthquakes and those not, is unaltered.

Table 5. First-difference estimation of earthquakes on religiosity

	(1)	(2)	(3)	(4)
Dependent variable: Change in "Importance of God"				
Earthquake dummy	0.057*	0.099***	0.108***	0.093***
	(0.028)	(0.030)	(0.028)	(0.024)
Observations	403	403	391	261
R-squared	0.423	0.434	0.473	0.313
Country-by-year FE	Y	Y	Y	Y
District controls	N	Y	Y	Y
Indl controls	N	N	Y	Y
Inc and edu dummies	N	N	N	Y
Countries	36	36	36	28
Districts	282	282	281	201

Notes. OLS estimates. The unit of analysis is a district. Dependent variable is the change in the regional average of answers to the question "How important is God in your life?" (0="not at all important",..., 1="very important"). The earthquake dummy is equal to one if one earthquake hit the district in between the interview waves, zero if no earthquake hit, and missing if more than one earthquake hit. District controls refers to the length of the time period in question and a measure of years since the earthquake. Indl controls indicates male and married dummies, age and age squared, controlled for before aggregation. Inc and edu FE indicates ten income dummies and eight education dummies, controlled for before aggregation. All columns include a constant. Standard errors are clustered at the country level. Asterisks ***, **, and * indicate significance at the 1, 5, and 10% level.

The AV-plot corresponding to column (3) of Table 5 is depicted in Figure 5, where the labels indicate countries. No countries seem to be driving the results. Throwing away India

[68] As stressed above, these individual level controls are included before aggregation to the district level. Hence, $impgod_{dct} = \sum_{i=1}^{N} e_{idct}$, where e_{idct} = residuals from regression of $impgod_{idct}$ on male, married, age, age squared in column (3) and likewise for column (4), where the 10 income dummies and 8 education dummies are added to the individual level regression.

(0.094), Vietnam (0.095), or Japan (0.115) does not alter the results (parameter estimates in paranthesis). Appendix C.5 shows more systematically that the impact of earthquakes is not driven by any particular continent.

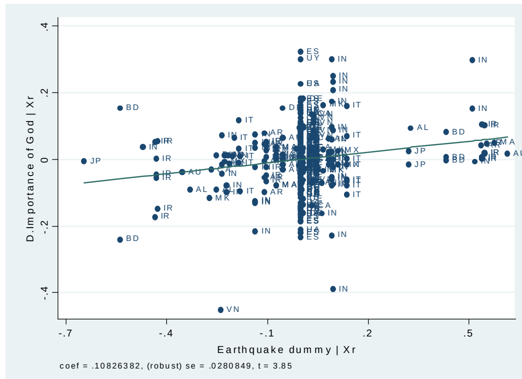


Figure 5. Added variable plot of religiosity change on earthquake dummy

Notes. AV-plot corresponding to column 3 of Table 5. Labels are ISO country codes.

Regarding economic significance, taking the estimate in column (3) of Table 5 at face value, having been struck by an earthquake means that religiosity is 10.8 percentage points higher compared to districts that did not experience an earthquake. This corresponds to the difference between the district with a median level of religiosity change and the district with a change corresponding to the 82$^{\text{nd}}$ percentile. In terms of standard deviations, a one standard deviation increase in the probability of being hit by an earthquake increases the change in religiosity by 0.025 units, corresponding to 20% of a standard deviation. Stating the cross-district result in terms of standard errors, a one standard deviation increase in long term earthquake risk increases religiosity by 0.024 units, amounting to 7% of a standard error.[69] Provided that we can compare the two earthquake probabilities, the fact that the short term effect is larger than the long run effect is consistent with the idea that individuals react to a sudden increased stress by increased believing, only to return to the more long term level after when their stress level has resumed.[70]

[69] The numbers are calculated using the results for the "Importance of God" measure, including the baseline controls corresponding to column (5) of Table 2.

[70] A one standard deviation in the distribution of actual earthquakes is 0.25, which means 25% higher chance of being hit by an earthquake above 5.0 on the Richter scale over the average period of 6.5 years. A one standard deviation in the distribution of long term earthquake risk is 0.45, which means 450 km closer to earthquake zones where the probability of being hit by an earthquake above 6.0 over within 50 years is high. While the units of measurement is hard to compare, the main point of the comparison is that the short term effect is larger than the long term, which seems very plausible, despite of the differences.

3.5.3 Placebo check

As a placebo check, column (1) of Table 6 uses a measure of future earthquakes, which should not influence religiosity. Indeed, the level of religiosity in districts that experience an earthquake in the future does not differ from the level in districts that do not experience an earthquake in the future (p-value > 0.6). Column (2) shows that this is not due to the reduced sample size: in this same sample, religiosity is higher in districts that experienced an earthquake in this period, compared to districts that did not, although only at the 14% level of significance. The size of the estimate matches the estimate in Table 5, column (3). The only controls in columns (1) and (2) are the individual-level controls and the country-by-year fixed effects. Columns (3) and (4) add the two baseline controls: period length and time since the last earthquake with no change to the conclusion.

Table 6. Palcebo check using future earthquakes

	(1)	(2)	(3)	(4)
Dependent variable: D.Importance of God				
Earthquake in period t+1	-0.010		-0.021	
	(0.020)		(0.039)	
Earthquake in period t		0.093		0.160**
		(0.059)		(0.058)
Observations	133	133	133	133
R-squared	0.000	0.034	0.287	0.330
Indlcontrols	Y	Y	Y	Y
Baseline controls	N	N	Y	Y

Notes. OLS estimates. The unit of analysis is a district. Dependent variable is the change in the regional average of answers to the question "How important is God in your life?" (0="not at all important",..., 1="very important"). Earthquake in period t+1 is a dummy equal to one if an earthquake hit in the period after the interview, while "Earthquake in period t" is a dummy equal to one if an earthquake hit in this period. In all regressions, individual-level controls for male, married, age and age squared, are controlled for before aggregation. Columns (3) and (4) additionally adds country-by-year fixed effects, period length in between the particular WVS-EVS waves and the number of years since the last earthquake. Standard errors are clustered at the country level. Asterisks ***, **, and * indicate significance at the 1, 5, and 10% level.

3.6 Study of persistency

Taken in isolation, the results found in the within-district analysis could cover a purely temporary effect of earthquakes on religiosity: Perhaps, people use their religion more intensively in the immediate aftermath of an earthquake, only to revert to their previous level of believing when the stress is gone.[71] On the other hand, while actual earthquakes are controlled

[71] That religiosity initially increases only to fall back towards previous levels is partly corroborated by 1) the results in Appendix C.3, where religiosity increases less in districts where the earthquakes happened earlier, albeit the effect cannot be distinguished from zero, 2) the fact that the short term effect is larger than the long term effect of earthquakes.

for in the cross-section analysis up to a certain level of lags, the results are most likely to cover long term effects. This section sheds further light on the existence of short- and/or long-term effects.

As dummies for earthquakes in the year of interview or the year before were included throughout the cross-sectional analysis, we know that these results were not due to short-term effects of earthquakes happening within the past year. Appendix B.5 shows that results are unaltered when including more lags, and furthermore documents the coexistence of short- and long-term effects: the impact of earthquake risk is smaller in districts where an actual earthquake hit recently.

To further investigate whether a long-term effect exists, I analyze whether children of immigrants are more religious when their mother came from a country with higher earthquake risk, compared to children of immigrants from low earthquake risk countries.[72]

For the measure of religiosity, I rely on data from the European Social Survey (ESS), which includes three questions on religiosity:[73,74] (1) How often do you pray? (1="Never", ..., 7="Every day"), (2) How religious are you? (1="Not at all religious", ..., 10="Very religious"), and (3) How often do you attend religious services? (1="Never", ..., 6="Weekly or more often").[75] I rescale the variables to measures between 0 and 1. I restrict the sample to include only persons born in the particular country, but whose mother was born in a different country.[76] This leaves me with 6,101 individuals with mothers migrating from 151 different countries.

I estimate equations of the form:

$$religiosity_{cjat} = \alpha + \beta earthquake_a + \lambda_t + a_c + X'_{cjt}\eta + W'_{at}\delta + V'_{ajt}\eta + \varepsilon_{cjat} \qquad (3)$$

where $religiosity_{cjat}$ is the level of religiosity of a child of immigrants j interviewed at time t living in country c in which he/she is also born, and whose parents migrated from country a. $earthquake_a$ measures the long term earthquake risk in the country of origin, measured by the distance to the nearest earthquake zone 3 or 4 (described in Section 3.4). a_c is a vector of country dummies wiping out country-wide effects of the immigrant-country of

[72] The method is called the epidemiological approach and relies on the assumption that cultural values are transferred across generations. See Fernandez (2011) for a handbook chapter.

[73] The ESS is available online at http://www.europeansocialsurvey.org/.

[74] Another dataset with information on immigrants' level of religiosity and country of origin is the General Social Survey (GSS) for the United States. However, the information on the origin of the immigrants is restricted to merely 32 units (comprising 30 countries and two broad regions), which is not enough for this type of empirical analysis, where the variation in earthquake intensity varies only across the country of origin.

[75] Religious services was originally a variable running from 1="Never" to 7="Every day". I recoded 7 to 6="Weekly or more often" to make the results comparable to the cross-individuals analysis. The results are unchanged if using the original variable.

[76] The literature on the epidemiological approach stresses that cultural influences come mainly from the mother.

residence. X_{cjt} is a vector of immigrant-level controls. W_{at} are socioeconomic and geographic factors in the immigrant's country of origin, which might correlate with disaster frequency. V_{ajt} is a vector of socioeconomic characteristics of the immigrant's mother and father.

β measures the impact of earthquake risk in person j's country of origin on person j's current religiosity. The estimate of β now does not include influences from factors in the immigrant's current environment, for instance institutions and culture. Perhaps more importantly, earthquake frequency in the immigrant's country of residence is removed.

The European Social Survey provides three measures of religiosity; people who (1) pray weekly or more often (columns (1)-(3) of Table 7), (2) identify themselves as religious (columns (4)-(6)), and (3) attend religious services regularly (columns (7)-(9)). The dataset comprises 6062 children of immigrants whose mothers came from 142 different countries.

Columns (1)-(3) of Table 7 show that the children of immigrants whose mother comes from a country located closer to a disaster zone pray more often than second generation immigrants whose mothers came from less disaster prone countries. This holds without any controls in column (1) and also controlling for country-by-year fixed effects (of the immigrants' current country of residence), geographical factors in the mothers' country of origin (absolute latitude, continents and distance to the coast), parent characteristics (mother's and father's education), individual-controls (immigrant's age, age squared, sex, income, education). Likewise, second generation immigrants whose mother came from a country frequently hit by natural disasters rank themselves as more religious.

The impact of earthquake frequency halves when using instead whether individuals attend religious services as the measure of religiosity. The impact becomes insignificant when all controls are included, confirming the cross-section results from Koenig *et al.* (1988) and Section 3.4 above: people do not engage in coping activities (church), but instead cope with the stress from earthquakes in a more spiritual way by increased beliefs etc.

The results are unchanged when using instead ordered logit estimation.

Table 7. OLS of religiousness on disasters in mothers' home country

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent variable:		pray			religious person			service	
Dist(earthquakes), 1000 km	-0.12***	-0.07***	-0.05**	-0.09***	-0.06***	-0.04*	-0.06**	-0.03*	-0.02
	(0.04)	(0.02)	(0.03)	(0.03)	(0.02)	(0.02)	(0.03)	(0.02)	(0.02)
Observations	5,971	5,971	5,116	6,002	6,002	5,142	6,037	6,037	5,169
R-squared	0.02	0.15	0.20	0.02	0.09	0.14	0.01	0.11	0.14
Org countries	142	142	124	142	142	124	142	142	124
Country and year FE	N	Y	Y	N	Y	Y	N	Y	Y
Geo controls	N	N	Y	N	N	Y	N	N	Y
Parent and indl controls	N	N	Y	N	N	Y	N	N	Y

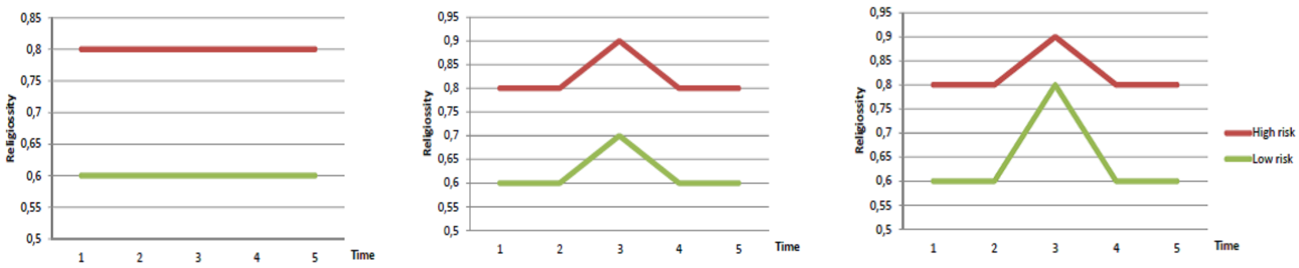
Notes. OLS estimates. The unit of analysis is a child of immigrants. The dependent variable is answers to the question: "How often do you pray?" (0="Never", ..., 1="Every day") in columns (1)-(3), "How religious are you?" (1="Not at all religious", ..., 1="Very religious") in columns (4)-(6), and "How often do you attend religious services?" (0="Never", ..., 1="Weekly or more often") in columns (7)-(9). Dist(earthquake) measures the distance to the nearest earthquake zone as depicted in Figure 1. "Country and year FE" indicates country - and year fixed effects of the time and place of interview of the children of immigrants. "Geo controls" indicates geographic controls of the country of origin: six continent dummies (Africa, Asia, Australia and Oceania, Europe, North America, and South America), absolute latitude, and distance to coast. "Parent and individual controls" indicates controls for mother's and father's level of education and controls for the child of immigrant's level of education, income, age, age squared, and sex. Standard errors are clustered at the level of immigrant's current country and mothers' country of origin. Asterisks ***, **, and * indicate significance at the 1, 5, and 10% level.

The results in Table 7 are consistent with the idea that high earthquake risk leaves a culture of high religiosity which is passed on through generations. Thus, people who have perhaps never themselves experienced an earthquake, are still influenced by the disasters experienced by earlier generations, as they have left a lasting imprint on their level of religiosity. The size of the impact is not significantly different from the effect found in the cross-sectional analysis across the globe; if anything, the effect is larger in the second generation immigrants regressions. This confirms the general finding throughout that disasters seem to leave a long-term effect on individuals' level of religiosity.

4 Combined results

The combined results can be visualized in the simple Figure 6 below, which combines more and more results as we move to the left. The figure is a mere illustration of the relative effects. Panel A illustrates the long term effect: religiosity is higher in high-earthquake-risk areas (main result shown in the cross-section study in Table 2 and the persistency study in Table 7). Panel B assumes that an earthquake hit both districts at time 3, which results in increased believing in the short run in both districts (main result from event study, shown in Table 5), which tends to return to the long run level after a while (Tables A15 and A17).[77] Panel C corrects the figure further by showing that the earthquake that hit the low-earthquake-risk district has a stronger effect on religiosity, compared to the earthquake that hit the high-earthquake-risk district (result shown in Tables A6 and A16), in line with the idea that religious coping is stronger for unpredictable events. The figure could be corrected further along various dimensions, but the point is simply to show how the short and long term effects coexist.

[77] Table A15 indicates that "a while" seems to be around 8 years.



A. Long term differences   B. Adding short term dynamics   C. Adding surprise effects

Figure 6. Combination of selected results

Notes. Illustration of the qualitative interplay between the results. The numerical differences are not accurate. The figure illustrates that a) differences in earthquake risk generates long term differences in religiosity, b) an earthquake striking at time 3 increases short term religiosity, which eventually falls back to the long term level, and c) the earthquake has a larger impact in low-risk districts.

5 Conclusion

Some of the least religious districts of the World today are the Berlin district of Germany, the Central Coast of Vietnam, and the Ustecky Kraj district of the Czech Republic with scores on the Strength of Religiosity Scale of 0.14-0.19. At the other end of the spectrum, with a Strength of Religiosity Scale score of nearly one, lies the North-West Frontier in Pakistan, the Borno district in Nigeria, and Jawa Tengah in Indonesia. This paper provides one explanation for these global differences in religiosity. Equivalently; since all societies were religious/spiritual if we go far enough back into history (see e.g., Brown (1991) and Murdock (1965)), this research gives one reason why secularization proceeded faster in some societies compared to others.

I find that individuals living in areas with high earthquake risk are more likely to believe in God, an Afterlife etc. across 900 subnational districts of the World. The tendency is the same within all major religions and within all continents. The impact is causal: District level religiosity increases in the aftermath of an earthquake. This is further confirmed in a placebo check: Religiosity does not react to future earthquakes.

The results can be explained within the religious coping framework; when faced with adverse life events, people tend to refer to their religion by praying, rationalizing the event religiously, etc. In consistence with this framework, unpredictable disasters influence religiosity, predictable ones do not; educated and employed individuals also cope in this way, though to a lesser extent that less educated and unemployed; intrinsic religiosity is affected more than church going. These results are inconsistent with insurance or selection explanations.

Regarding timing, the results indicate that individuals react immediately to earthquakes by increased believing, only to revert back after a while towards the more long-term level of religiosity determined by the earthquake risk of the individual's ancestors. Existence of a long-term effect is confirmed in various tests: First, children of immigrants are more religious when their mother came from a high-earthquake-risk country, even though the children never lived in that country. Second, the effect of long-term earthquake risk persists after controlling for actual earthquakes, but is reduced when an actual earthquake hit the district.

This research further provides one explanation of the apparent paradox that religiosity might not decline with increased wealth and knowledge as suggested by the modernization hypothesis. Further, if religiosity is rooted in the uncertainty of our natural surroundings, and if the impact found in the present study extends to other natural phenomena, climate change may have a yet unexplored consequence.

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Appendix - potentially for online publication

A Matching subnational districts

Steps in matching gridded data with the regional information in the pooled WVS/EVS:

1. The disaster data is available at the grid-cell level, while the finest spatial information in the pooled WVS/EVS 1984-2009 is variable x048 indicating the subnational district where the interview was conducted. The WVS/EVS "districts" can be both actual districts, but in a few cases also cities. To match the two types of information, I use a shapefile from ESRI with first administrative districts across the globe, which means a unit of disaggregation just below the country-level.

2. The ESRI-shapefile also has information on the type of land within the district, which is: primary land, large island, medium island, small island, very small island. To prevent averaging across for instance islands and primary land, I rank the five categories with primary land as the preferred and very small island as the least preferred. In those cases, where a district is divided into several polygons, I keep only the highest ranked polygon. Averaging over the entire mix of land polygons makes no difference for the results.

3. In many cases, the x048 variable varies across time. For instance, the same country can be divided into 15 districts in one year and only five larger districts in another year. I pick the year(s) where the country is divided into as many districts as possible, but at the same time match the shapefile for first administrative districts as good as possible.

4. For many countries, the level of aggregation in the ESRI shapefile is different from that in the district identifier, x048, from EVS/WVS. In these cases, I aggregate to the finest level possible.

5. The districts are illustrated in Figure A1 below:

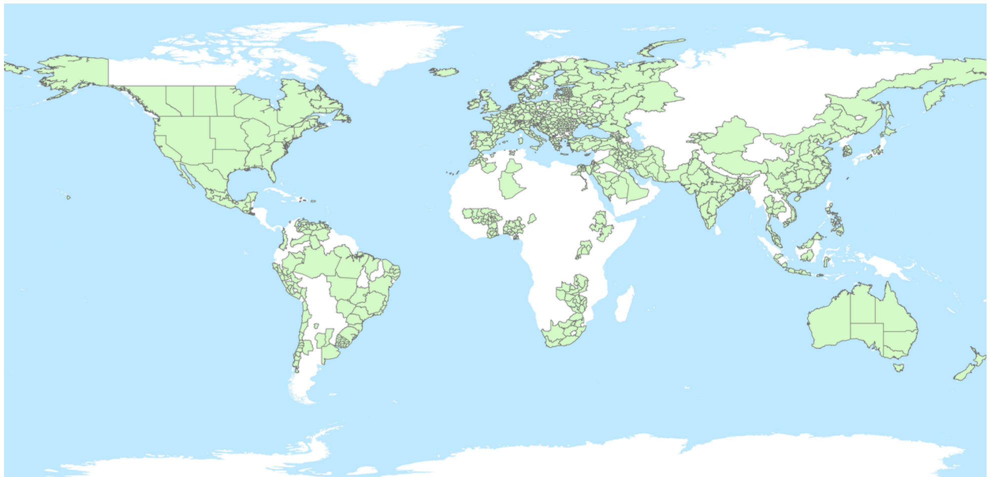


Figure A1. Subnational districts included in the analysis.

Source: Own matching of the variable x48 in the pooled EVS-WVS 1981-2009 dataset to the ESRI shapefile of global first administrative units.

B Additional results for cross-district analysis

Most tables in this appendix replicates column (5) of Table 2 with various robustness checks. For external validity, many tables also include answers to the question "How important is God in your life?" as a dependent variable, as this question has more respondents than the composite Strength of Religiosity measure.

B.1 Summary statistics

Table A1. Summary statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Strength of Religiosity Scale	106,054	.736	.296	0	1
Dist(earthquakes) 1000 km	211,883	.441	.544	0	3.355
Age	207,293	41.602	16.555	15	108
Male	209,899	.478	.500	0	1
Married dummy	211,193	.575	.494	0	1
Absolute latitude	211,883	34.174	15.064	.119	67.669
Dist(coast) 1000 km	211,883	.239	.257	0	1.990
Area	211,883	130985	298813	.000	2,997,855
Earthquake dummy period t	211,883	.042	.201	0	1
Year	211,883	2002	6.060	1981	2009

B.2 Number individuals in each subnational district

All main regressions were estimated for districts with more than 10 respondents per year. Table A2 shows that the results do not seem to depend on the chosen cutoff. All estimations include the full set of exogenous controls used throughout the cross-sectional analysis.

The measure of religiosity in columns (1) through (4) is the Strength of Religiosity Scale, while the measure in columns (5) through (8) is the "Importance of God" measure. Columns (1) and (6) show the main result on the full sample for the Religiosity Scale and "Importance of God" religiosity measures respectively, while the following columns throw away districts with less than 10, 50, and 100 respondents respectively.

Table A2. Removing districts with few respondents

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep. var.:	rel	rel	rel	rel	impgod	impgod	impgod	impgod
Dist(earthq), 1000km	-0.061***	-0.061***	-0.062***	-0.068***	-0.054***	-0.054***	-0.059***	-0.066***
	(0.016)	(0.016)	(0.017)	(0.021)	(0.014)	(0.014)	(0.016)	(0.020)
Observations	103,362	103,281	98,307	88,081	198,526	198,263	187,178	164,581
R-squared	0.333	0.332	0.331	0.327	0.400	0.400	0.401	0.390
Baseline controls	Y	Y	Y	Y	Y	Y	Y	Y
Sample	Full	>10	>50	>100	Full	>10	>50	>100
Districts	600	591	450	315	911	884	646	433
Avg no indls	360.3	360.6	376.9	411.6	333.5	334.0	351.6	389.2

Notes. OLS estimates. The table replicates the result in column (5) of Table 2, varying the limit for the minimum number of respondents in the district and varying the dependent variable. The dependent variable in columns (1)-(4) is Inglehart's Strength of Religiosity Scale [0,1] (rel). The dependent variable in columns (5)-(8) is answers [0,1] to the question "How important is God in your life?" (impgod). All regressions include country - and year fixed effects, individual controls for respondent's age, age squared, sex, and marital status, geographic subnational district level controls for absolute latitude, distance to the coast, area, and earthquake dummies for whether an earthquake hit in the year of interview or the year before. The standard errors are clustered at the level of subnational districts. All columns include a constant. Asterisks ***, **, and * indicate significance at the 1, 5, and 10% level.

One concern is the fact that different districts have different numbers of respondents, which may bias the results. Table A3 weights the district observations by the number of respondents in each district for all the regressions in Table 2. The estimates of the earthquake distance parameters and standard deviations are unaltered.

Table A3. OLS of religiosity on earthquake distance weighted by number respondents

	(1)	(2)	(3)	(4)	(5)	(6)
Strength of Relgiosity Scale [0;1]						
Dist(earthq), 1000km	-0.139***	-0.068***	-0.059***	-0.055***	-0.056***	-0.057***
	(0.036)	(0.017)	(0.016)	(0.016)	(0.016)	(0.013)
Observations	105,947	105,947	105,947	103,283	103,281	66,112
R-squared	0.045	0.273	0.281	0.310	0.310	0.267
Country FE	N	Y	Y	Y	Y	Y
Year FE	N	N	Y	Y	Y	Y
Indl controls	N	N	N	Y	Y	Y
Geo controls	N	N	N	N	Y	Y
Inc and edu FE	N	N	N	N	N	Y

Notes. OLS estimates. The only difference between this table and Table 2 is that the observations are weighted with the number of respondents in each district.

B.3 Different earthquake zones

The main measure of earthquake intensity throughout the paper is the distance to earthquake zones 3 or 4. Table A4 shows that the results do not depend on the choice of zones.

Table A4. Alternative earthquake measures

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep. var.:	rel	rel	rel	rel	impgod	impgod	impgod	impgod
Distance to earthq zone 1-4	-0.052*				-0.077***			
	(0.028)				(0.026)			
Distance to earthq zone 2-4		-0.072***				-0.056***		
		(0.028)				(0.020)		
Distance to earthq zone 3-4			-0.061***				-0.054***	
			(0.016)				(0.014)	
Distance to earthq zone 4				-0.021**				-0.015*
				(0.008)				(0.009)
Observations	103,281	103,281	103,281	103,281	198,263	198,263	198,263	198,263
R-squared	0.332	0.332	0.332	0.332	0.400	0.400	0.400	0.400
Baseline controls	Y	Y	Y	Y	Y	Y	Y	Y
Districts	591	591	591	591	884	884	884	884
Countries	66	66	66	66	85	85	85	85

Notes. The tabel replicates column (5) of Table 2, where the dependent variable in columns (1)-(4) is Inglehart's Strength of Religiosity Scale [0,1] (rel) and the dependent variable in columns (5)-(8) is answers [0,1] to the question "How important is God in your life?" (impgod). Dist(earthquake) measures the distance in 1000 km to the nearest earthquake-zones 1-4 in columns (1) and (5), distance to zones 2-4 in columns (2) and (6), distance to zones 3-4 in columns (3) and (7), and distance to zone 4 in columns (4) and (8). All regressions include country - and year fixed effects, individual controls for respondent's age, age squared, sex, and marital status, geographic subnational district level controls for absolute latitude, distance to the coast, area, and earthquake dummies for whether an earthquake hit in the year of interview or the year before (Baseline controls). The standard errors are clustered at the level of subnational districts. All columns include a constant. Asterisks ***, **, and * indicate significance at the 1, 5, and 10% level.

B.4 Mean earthquake zones

Table A5 shows results using an alternative measure of earthquake intensity, namely the average across the earthquake zones depicted in Figure 2.

Table A5. OLS of religiosity on average earthquake zones

	(1)	(2)	(3)	(4)
Dep. var.:	rel	rel	impgod	impgod
Average earthquake zone	0.022	-0.018	0.057***	0.029
	(0.021)	(0.024)	(0.019)	(0.020)
Dist(earthquakes)		-0.067***		-0.045***
		(0.019)		(0.016)
Observations	103,052	103,052	197,910	197,910
R-squared	0.332	0.332	0.400	0.400
Baseline controls	Y	Y	Y	Y
Districts	588	588	881	881
Countries	66	66	85	85

Notes. The table replicates column (5) of Table 2, but with mean earthquake zones as the earthquake measure instead. The dependent variable in columns (1)-(2) is Inglehart's Strength of Religiosity Scale [0,1] (rel). The dependent variable in columns (3)-(4) is answers [0,1] to the question How important is God in your life? (impgod). Average earthquake zone measures the average earthquake zone within the district calculated across earthquake zones in Figure 1. Dist(earthquake) measures the distance in 1000 km to the nearest high-intensity earthquake-zone (zones 3 or 4). All regressions include country - and year fixed effects, individual controls for respondent's age, age squared, sex, and marital status, geographic subnational district level controls for absolute latitude, distance to the coast, area, and earthquake dummies for whether an earthquake hit in the year of interview or the year before (Baseline controls). The standard errors are clustered at the level of subnational districts. All columns include a constant. Asterisks ***, **, and * indicate significance at the 1, 5, and 10% level.

B.5 Actual earthquakes

Table A6 adds dummies for actual earthquakes during the past three years up to the WVS interviews in columns (1)-(3).[78] The estimate of the long-term earthquake risk is unchanged. The results are robust to including many more lags (results available upon requaest). Columns (4)-(6) include interaction terms with the earthquake dummies and the long-term earthquake risk. Column (4) shows that long-term earthquake risk is lower in districts that were hit by an earthquake in the year just before the WVS interview, which indicates that a short-term effect does exist. The sign and significance of long-term earthquake risk is maintained for the vast majority of the sample. The median district retains the effect of long-term earthquake risk of -0.062 seen throughout. Furthermore, the mean distance to earthquake zones 3 or 4 for the 21 districts hit by an earthquake within the past

[78] As in the within-district analysis, I have removed all districts, where an earthquake hit in the year of interview, since I do not know whether the earthquake in this particular year hit before or after the WVS interview.

year is 0.012. At this level, the composite impact of long-term earthquake risk is -0.048.[79]

Table A6. Accounting for actual earthquakes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dep. var.: Strength of Religiosity Scale [0;1]							
Dist(earthq), 1000km	-0.062***	-0.062***	-0.062***	-0.062***	-0.062***	-0.061***	-0.061***
	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)
Earthq t-1		-0.001	-0.002	-0.002	-0.022*	-0.026**	-0.026**
		(0.012)	(0.012)	(0.011)	(0.012)	(0.012)	(0.012)
Earthq t-2			0.005	0.005		0.013*	0.015*
			(0.009)	(0.010)		(0.008)	(0.008)
Earthq t-3				-0.002			-0.007
				(0.009)			(0.009)
Dist(earthq) X earthq t-1					1.142***	1.165***	1.145***
					(0.287)	(0.287)	(0.302)
Dist(earthq) X earthq t-2						-0.210	-0.234
						(0.141)	(0.155)
Dist(earthq) X earthq t-3							0.746***
							(0.267)
Observations	98,642	98,640	98,640	98,640	98,640	98,640	98,640
R-squared	0.330	0.330	0.330	0.330	0.330	0.330	0.330
Baseline controls	Y	Y	Y	Y	Y	Y	Y

Notes. OLS estimates. The unit of analysis is individuals surveyed in the pooled WVS / EVS. The dependent variable is Inglehart's Strength of Religiosity Scale [0,1], which is an average (principal components analysis) of answers to six questions on religiosity, depicted in Table 1. Dist(earthquake) measures the distance in 1000 km to the nearest high-intensity earthquake-zone (zones 3 or 4) as depicted in Figure 1. All columns include country fixed effects, time fixed effects, individual-level controls for respondent's age, age squared, sex, and marital status, geographic controls for absolute latitude, distance to the coast, and area. The sample includes only districts that were not hit by an earthquake in the same year as the WVS interview. The standard errors are clustered at the level of subnational districts in parenthesis. All columns include a constant. Asterisks ***, **, and * indicate significance at the 1, 5, and 10% level.

B.6 Additional controls

Table A7 includes additional district-level controls. Columns (2)-(9) add controls for trust (variable a165 from the pooled EVS-WVS), population density, light density at night per square km (spatial data available from NASA), arable land shares (calculated based on irrigated and rainfed agriculture, plate 47 from FAO), district size, average temperatures (spatial data from GAEZ), average precipitation and variation therein (spatial data from GAEZ).[80]

[79] The composite impact of the actual earthquake is -0.021+0.016*1.142=-0.003, statistically indistinguishable from zero.

[80] In accordance with the work by Ager & Ciccone (2014), I find that increased within-year variation in precipitation increases religiousness. In addition, in accordance with the hypothesis by Ager & Ciccone (2014), I find that the variance of precipitation has no impact in the sample with arable land shares below

The impact of earthquake risk on religiosity is unchanged. Last, given the construction of the disaster measure, one may be concerned that the result is driven by the difference between zero disaster distance and "the rest". Thus, column (9) includes a dummy equal to one if earthquake distance is larger than zero, while column (10) excludes all districts with earthquake distance zero. Both columns confirm that the main identified effect of earthquake risk is not caused by the difference between zero and non-zero distances. All controls are included simultaneously in column (11). The estimate of earthquake risk stays remarkably stable throughout all columns.

The variable resulting in the largest reduction in the relation between earthquake distance and religiosity is arable land, which reduces the estimate from 0.061 to 0.058. If any omitted variable should render the estimate of interest insignificant at the 5% level, it should result in a ten times larger reduction compared to the reduction caused by arable land.

the median (indicating less dependency on agriculture historically). The impact of natural disaster remains unchanged in this sample (results are available upon request).

Table A7. Additional controls

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Dep. var.: Strength of Religiosity Scale											
Dist(earthq), 1000km	-0.061***	-0.062***	-0.060***	-0.060***	-0.058***	-0.061***	-0.061***	-0.059***	-0.064***	-0.056***	-0.058***
	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.017)	(0.018)	(0.016)
Trust		0.005									0.005
		(0.003)									(0.003)
Popdens 2000			-0.004**								-0.003**
			(0.002)								(0.001)
Lights per km2, 2000				-2.228*							-107.013
				(1.339)							(90.942)
Arable land (%)					-0.018						-0.025**
					(0.011)						(0.012)
Avg temp 1961-90						0.000					0.000
						(0.001)					(0.001)
Prec 1961-90							0.015				0.002
							(0.010)				(0.016)
Var(prec) 1961-90								0.125***			0.135*
								(0.043)			(0.071)
Disaster>0									0.009		0.013
									(0.010)		(0.010)
Observations	103,281	100,323	103,281	103,077	103,281	102,395	102,395	102,395	103,281	84,419	99,481
R-squared	0.332	0.332	0.333	0.333	0.333	0.333	0.333	0.333	0.333	0.335	0.333
Baseline controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Sample	full	full	full	full	full	full	full	full	full	nonzero	full

Notes. OLS estimates. The dependent variable is the Religiosity Scale measure. The unit of analysis is an individual. All regressions include country - and year fixed effects, individual controls for respondent's age, age squared, sex, and marital status, geographic subnational district level controls for absolute latitude, distance to the coast, area, and earthquake dummies for whether an earthquake hit in the year of interview or the year before (Baseline controls). Sample indicates whether it is the full sample or the sample restricted to non-zero disaster-distances. Standard errors are clustered at the subnational district level. Asterisks ***, **, and * indicate significance at the 1, 5, and 10% level.

B.7 Functional form

Table A8 tests the functional form of the relation between earthquakes and religiosity by restricting the sample in increments of 500 km, taking the logarithm, and including a squared term.

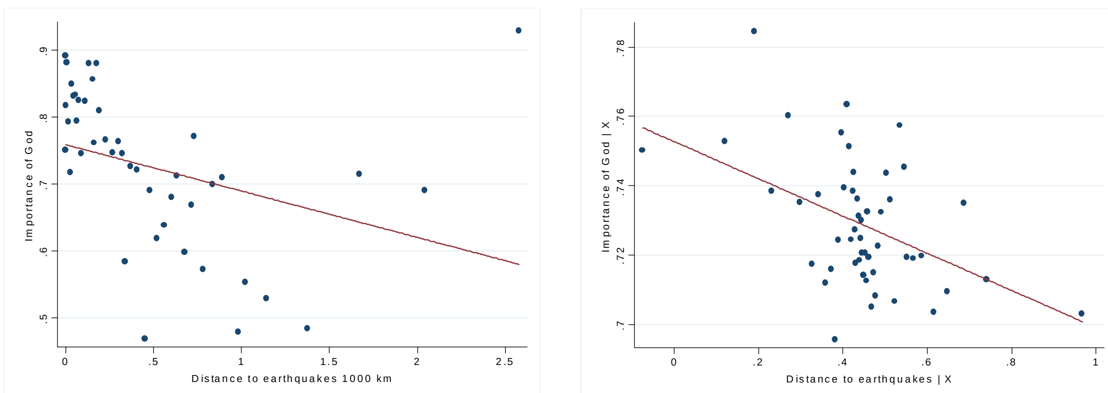
Table A8. Testing the functional form

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Dependent variable: Strength of Religiosity Scale						
Dist(earthq), 1000km	-0.061***	-0.062***	-0.073***	-0.061		-0.064**
	(0.016)	(0.019)	(0.020)	(0.041)		(0.026)
log (1+) Dist(earthq)					-0.089***	
					(0.024)	
Dist(earthq), squared						0.003
						(0.012)
Observations	103,281	100,421	96,418	73,592	103,281	103,281
R-squared	0.332	0.332	0.334	0.314	0.332	0.332
Districts	591	565	503	379	591	591
Countries	66	65	62	52	66	66
Panel B: Dependent variable: Importance of God						
Dist(earthq), 1000km	-0.054***	-0.071***	-0.075***	-0.100***		-0.088***
	(0.014)	(0.018)	(0.020)	(0.036)		(0.023)
log (1+) Dist(earthq)					-0.095***	
					(0.024)	
Dist(earthq), squared						0.020***
						(0.007)
Observations	198,263	186,942	175,652	131,055	198,263	198,263
R-squared	0.400	0.397	0.399	0.396	0.400	0.400
Districts	884	809	723	556	884	884
Countries	85	81	76	65	85	85
Baseline controls	Y	Y	Y	Y	Y	Y
Sample	Full	<1500 km	<1000 km	<500 km	Full	Full

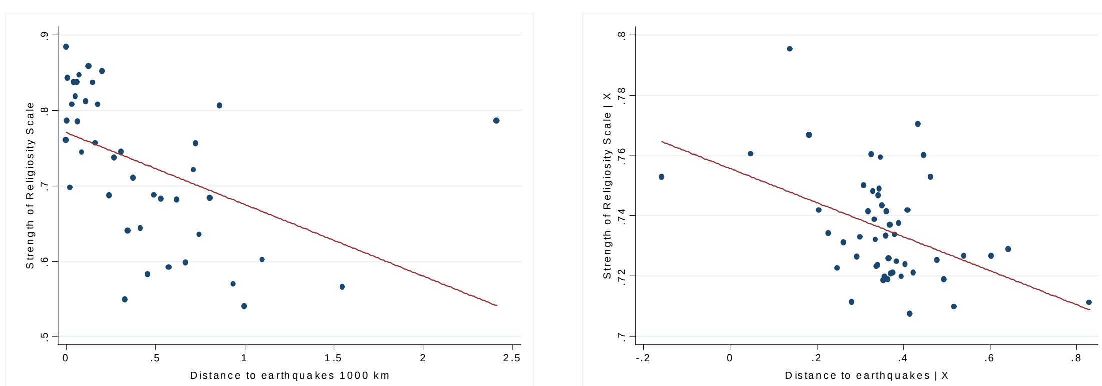
Notes. OLS estimates. The unit of analysis is an individual. The dependent variable in columns (1)-(4) is Inglehart's Strength of Religiosity Scale [0,1]. The dependent variable in columns (5)-(8) is answers [0,1] to the question How important is God in your life? Dist(earthquake) measures the distance in 1000 km to the nearest high-intensity earthquake-zone (zones 3 or 4). All regressions include country - and year fixed effects, individual controls for respondent's age, age squared, sex, and marital status, geographic subnational district level controls for absolute latitude, distance to the coast, district area, and earthquake dummies for whether an earthquake hit in the year of interview or the year before. The standard errors are clustered at the level of subnational districts. All columns include a constant. Asterisks ***, **, and * indicate significance at the 1, 5, and 10% level.

To further investigate the functional form, Figure A2 depicts binned scatterplots where distance to earthquakes is divided into 50 bins with equally many individuals in each.[81] The religiosity measure is Importance of God in the top panels and the Strength of Religiosity Scale in the bottom panels. The left panels depict the simple correlation without controls, while the right panels include all controls from column (5) of Table 2. The scatters confirm the non-linear relationship: The correlation between earthquake distance and religiosity is higher for lower earthquake distances, and reduces in absolute size as earthquake distance increases. The controls seem to remove this tendency somewhat, making the relation between religiosity and disaster distance more linear. We see that the reason why the non-linearity is not to be found when using the Religiosity Scale including all controls is that there are fewer observations with high religiosity.

Religiosity measure: Importance of God



Religiosity measure: Strength of Religiosity Scale



Left panels: Simple correlation Right panels: Including controls

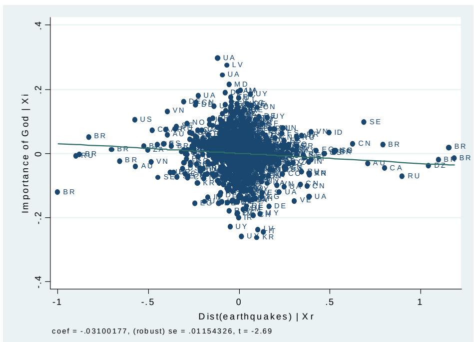
Figure A2. Binned scatter plots of earthquake distance and religiosity

Notes. Binned scatterplots of religiosity and distance to earthquake zones. Earthquake distance is divided into 50 equally sized bins, based on the number of respondents, indicated by one dot. The red line indicates

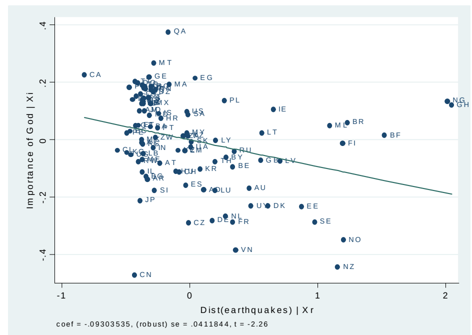
[81] Bins are created automatically by the binscatter procedure in stata, which means that individuals are divided into 50 equally sized groups. Creating the bins based on groups with the same number of districts in each generates much the same picture.

the fitted line of the corresponding OLS regression. The religiosity measure is the Strength of Religiosity Scale. The left panels includes no controls, while the right panels include country and year fixed effects, individual level controls for respondent's age, age squared, sex, and marital status, and subnational district level controls for absolute latitude, distance to the coast, area, and earthquake dummies for whether an earthquake hit in the year of interview or the year before.

B.8 Additional AV-plots



District aggregates



Country aggregates

Figure A3. AV-plots of religiosity on earthquake frequency

Notes. AV-plots of OLS estimation, only difference to Figure 3 is that the dependent variable is "Importance of God".

B.9 Alternative measures of religiosity

Table A9 displays the results from estimating equation (1) using each of the six subcomponents of the Strength of Religiosity Scale individually.[82] The baseline controls are included in all columns.[83] The results using the basic Religiosity Scale measure is reproduced in column (1), while columns (2)-(7) show the results for each subcomponent. Higher earthquake risk increases all six measures of religiosity significantly. The average effect on religiosity estimated so far covers large variation across religiosity measures: The smallest estimates obtained when using church attendance or "Do you believe in God" are three times smaller than the highest estimate emerging when using "Do you believe in an Afterlife".[84] In accordance with the study by Koenig *et al.* (1988), church attendance is among the least affected religiosity measures, while measures of the degree of believing are the most affected.[85]

[82] A previous version of the paper performs the above analysis for each of the six religiousness measures that enter the Strength of Religiousity Scale and six additional measures with no change to the main conclusions.

[83] Most measures of religiosity are dummy variables, while others are categorical variables. The conclusions are unchanged if instead using probit or ordered probit estimation, respectively.

[84] The difference in estimates does not seem to be due to the different samples.

[85] The result of a small effect on church attendance is unaltered if one instead used a church attendance dummy equal to one if the person goes to church once a month or more often (this dummy splits the sample

Table A9. Varying measures of religiosity

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent variable:	rel	impgod	comfort	believe	relpers	afterlife	service
Dist(earthq), 1000km	-0.061***	-0.054***	-0.058***	-0.031*	-0.050***	-0.120***	-0.038**
	(0.016)	(0.014)	(0.020)	(0.018)	(0.019)	(0.026)	(0.016)
Observations	103,281	198,263	126,194	129,909	192,119	120,071	196,859
R-squared	0.332	0.400	0.260	0.223	0.198	0.198	0.270
Baseline controls	Y	Y	Y	Y	Y	Y	Y
Districts	591	884	611	592	880	592	868
Countries	66	85	67	66	84	66	83

Notes. OLS estimates. The unit of analysis is individuals surveyed in the pooled WVS / EVS. The dependent variable in column (1) is the Strength of Religiosity Scale [0,1] (rel), while the dependent variables in columns (2)-(7) are the subcomponents of this measure (when nothing else is indicated, they are dummy variables with 1="yes", 0="no"): column (2): How important is God in your life? (0="not at all important",..., 1="very important") (impgod), column (3): Do you get comfort and strength from religion? (comfort), column (4): Do you believe in God?, column (5): Are you a religious person? (believe), column (6): Do you believe in life after death? (after), and column (7): How often do you attend religious services? (0="Never, practically never", ..., 1="More than once a week") (service). Dist(earthquake) measures the distance in 1000 km to the nearest high-intensity earthquake-zone (zones 3 or 4) as depicted in Figure 1. All controls from column (5), Table 2 included in all columns. The standard errors are clustered at the level of subnational districts. All columns include a constant. Asterisks ***, **, and * indicate significance at the 1, 5, and 10% level.

B.10 Global extent of religious coping

The literature investigating the religious coping hypothesis is mainly concentrated around the West. Hence, so far no conclusions can be drawn as to whether Muslims, Buddhists, or Hindus cope in the same way as Christians. In fact, the results so far could potentially be driven by Christians only.

I investigate this by allowing for differential effects of earthquake frequency within the major religions, estimating the following equation:

$$religiosity_{idct} = \alpha + \beta_1 disasters_{dc} + \beta_2 disasters_{dc} \cdot I^g_{idct} + \beta_3 I^g_{idct} + \lambda_t + a_c + X'_{dc}\eta + W'_{idct}\delta + \varepsilon_{idct} \quad (4)$$

where I^g are dummy variables equal to one if individual i belonged to the religious denomination g at time t. g refers to one of the five religions: Christianity, Islam, Buddhism, Hinduism and Other religions.[86] $\beta_1 + \beta_2$ is the impact of earthquake frequency for individuals

in two equally sized groups).

[86] The major religions are based on answers to the question "Which religious denomination do you belong

belonging to religion g.[87]

Table A10 shows estimation results for equation 4, including all the exogenous baseline controls. Column (1) includes no interaction effects, but simply restricts the sample to the sample where information on individuals' religious denomination is available. The mere restriction of the sample lowers the estimate in absolute value from -0.061 (column 5, Table 2) to -0.045. The reason for the reduction is that we are now comparing people with more similar (higher) levels of religiosity.[88]

Column (2) tests whether Christians react differently to earthquakes than the rest of the World population. On average, Christians do not seem to react differently from the rest, but this covers the fact that Catholics seem to react less than average (column 3), while Protestants react more (column 4).[89] Columns (5), (6), and (8) show that neither Muslims, Hindus nor the Other category react differently than average. Column (7) shows that Buddhists do not seem to react to earthquake frequency in terms of elevated religiosity. This estimate should not be taken too seriously, as Buddhists only amount to 1% of the sample. If we nevertheless took the result seriously, it could be due to the fact that Buddhists are the least religious group with an average score on the Religiosity Scale of 0.59 versus 0.81 for the average World citizen in the sample of Table A10.[90]

The finding that religious coping is used by adherents to most of the major religions is consistent with the study by Gillard & Paton (1999), who asked Fijians three weeks after Hurricane Nigel in 1997 about their coping strategies. 89% of Christians, 76% of Hindus, 63% of Muslims responded that their respective beliefs were helpful during the crisis.

to?" (question f025). There are 84 different answers, which I have grouped into the major religions and "Other". The religions that I have grouped into "Other" cover mainly religious denominations reported as "Other" (54% of the total "Other" group) in the WVS/EVS, Jews (21%), and Ancestral worshipping (13%).

[87] In a previous version of the paper, I include all religious denominations simultaneously in the equation, which I estimate for each of the six religiousness measures that enter the Strength of Religiousity Scale with no change to the main conclusion.

[88] The average level of the Religiosity Scale is 0.74 in the full sample versus 0.81 in the sample, where respondents have answered which religious group they belong to.

[89] The stronger reaction of Protestants is despite the fact that Protestants live in districts with the lowest earthquake frequency of all adherents (an average distance of 683 km versus 342 km for the average district in the sample of Table 5).

[90] The remaining religious denominations are relatively similar in terms of their level of religiosity.

Table A10. Across religious denominations

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep. var.: Strength of Religiosity Scale								
Dist(earthquakes), 1000 km	-0.045***	-0.050***	-0.057***	-0.037**	-0.042***	-0.040***	-0.046***	-0.047***
	(0.014)	(0.017)	(0.014)	(0.015)	(0.014)	(0.012)	(0.014)	(0.014)
Dist(earthquakes) X Christian		0.008						
		(0.011)						
Dist(earthquakes) X Catholic			0.029***					
			(0.010)					
Dist(earthquakes) X Protestant				-0.026**				
				(0.011)				
Dist(earthquakes) X Muslim					-0.010			
					(0.012)			
Dist(earthquakes) X Hindu						-0.032		
						(0.044)		
Dist(earthquakes) X Buddhist							0.104*	
							(0.054)	
Dist(earthquakes) X Other								0.017
								(0.015)
Observations	84,863	84,863	84,863	84,863	84,863	84,863	84,863	84,863
R-squared	0.245	0.246	0.246	0.246	0.248	0.245	0.245	0.245
Baseline controls	Y	Y	Y	Y	Y	Y	Y	Y
Districts	580	580	580	580	580	580	580	580
Districts in group		528	505	341	263	60	87	295

Notes. OLS estimates. The unit of analysis is individuals surveyed in the pooled WVS / EVS. The dependent variable is the Strength of Religiosity Scale [0,1]. Dist(earthquake) measures the distance in 1000 km to the nearest high-intensity earthquake-zone (zones 3 or 4) as depicted in Figure 1. All controls from column (5), Table 2 included in all columns. In addition, column (2) includes an interaction term between Dist(earthquake) and a dummy variable equal to one if the person adheres to Christianity together with the dummy variable itself. Likewise for the remaining religious denominations: The particular columns include the interaction term and the dummy itself. The standard errors are clustered at the level of subnational districts. Asterisks ***, **, and * indicate significance at the 1, 5, and 10% level.

In the same vein as with religious denominations, Table A11 allows the impact of distance to earthquakes to vary across continents by including the interaction term $disaster \cdot I_g$, where I_g is a dummy variable equal to one if the individual lives on that particular continent. The impact of distance to earthquake zones does not vary across continents, except that Americans seem to engage less in religious coping.

Table A11. OLS results across continents

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. var.: Strength of Religiosity Scale						
disaster	-0.061***	-0.071***	-0.053***	-0.063***	-0.057***	-0.062***
	(0.016)	(0.021)	(0.014)	(0.019)	(0.020)	(0.018)
Dist(earthquakes) X America		0.048				
		(0.034)				
Dist(earthquakes) X Europe			-0.065			
			(0.078)			
Dist(earthquakes) X Asia				0.007		
				(0.039)		
Dist(earthquakes) X Africa					-0.012	
					(0.033)	
Dist(earthquakes) X Oceania						0.019
						(0.046)
Observations	103,281	103,281	103,281	103,281	103,281	103,281
R-squared	0.332	0.333	0.333	0.332	0.332	0.332
Continent	All	America	Europe	Asia	Africa	Oceania
Country FE	Y	Y	Y	Y	Y	Y
Baseline controls	Y	Y	Y	Y	Y	Y
Inc and edu FE	N	N	N	N	N	N
Districts	591	591	591	591	591	591
Districts within group		97	262	154	69	9

Notes. OLS estimates. The dependent variable is the Strength of Religiosity Scale [0,1]. The unit of analysis is individuals surveyed in the pooled WVS / EVS. Dist(earthquake) measures the distance to the nearest earthquake-zone as depicted in Figure 1. Mean earthquake zones measures the mean value of earthquake zones, which ranges from zero to six. All controls from column (5), Table 2 included in all columns. The standard errors are clustered at the level of subnational districts. All columns include a constant. Asterisks ***, **, and * indicate significance at the 1, 5, and 10% level.

B.11 Additional disasters

The tropical storm intensity zones are based on the probability of occurrence of storms falling within five wind speed categories of the Saffir-Simpson Hurricane Scale.[91] The five wind speed categories are: 1) 118-153 km/h, 2) 154-177 km/h, 3) 178-209 km/h, 4) 210-249 km/h, and 5) 250+ km/h. The Storm Intensity Zone layer shows areas where each of these wind speed categories has a 10% probability of occurring within the next 10 years. For each district, I calculate the distance to storm intensity zones 2 or above. Storm intensity zones 2 or above are depicted in Figure A4 below as the dark blue areas.

The volcano intensity zones shows the density of volcanic eruptions based on the explosivity index for each eruption and the time period of the eruption. Eruption information is spread to 100 km beyond point source to indicate areas that could be affected by volcanic emissions or ground shaking. The source of the data is worldwide historical volcanic

[91] Made available online at U.S. Geological Survey: http://www.usgs.gov/.

eruptions occurring within the last 10,000 years (to 2002) from Siebert & Simkin (2002).[92] The volcanic eruptions were rated using the Volcanic Explosivity Index (VEI), which is a simple 0-to-6 index of increasing explosivity, with each successive integer representing about an order of magnitude increase. For each district, I calculate the distance to volcano risk zones 2 or above. These zones are depicted by the orange areas in Figure A4 below.

I have not been able to find similar zone data for tsunamis. Instead, the tsunami measure is simply the distance from each district to the nearest tsunami ever recorded. The data on tsunami events is from the Global Historical Tsunami Database from the National Geophysical Data Center (NOAA). The events since 2000 BC were gathered from scientific and scholarly sources, regional and worldwide catalogs, tide gauge reports, individual event reports, and unpublished works. The tsunamis are depicted as the triangles in Figure A4 below.

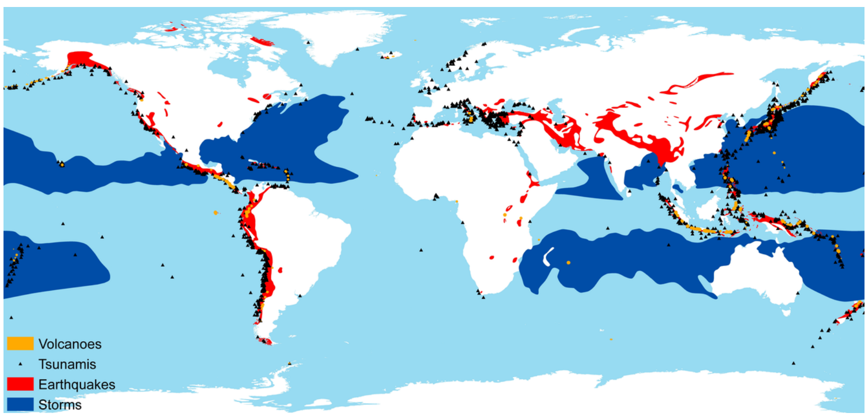


Figure A4. Disaster zones.

B.12 Degrees of religious coping

The literature on religious coping hypothesizes that some individuals engage more in religious coping than others, mainly those with fewer alternative coping strategies and limited means (testable implication 5). Table A12 investigates this by including various interaction terms.

The pooled WVS-EVS provides three measures of the means available to the individual; education levels, income levels, and whether the person is unemployed or not.[93]

Column (1) of Table A12 interacts earthquake distance with the education variable from the pooled WVS-EVS measuring the level of education on a scale from 1 to 8, where 8 is the highest. More educated people do not seem to react differently to natural disasters than the rest in terms of religious coping. However, column (2) shows that earthquakes matter

[92] The data was produced digitally by the Smithsonian Institution's Global Volcanism Program, http://www.volcano.si.edu/index.cfm.

[93] Potentially many more variables from the pooled WVS-EVS can be used to investigate testable implication 5. Here, I have tried to use the variables already included in the analysis, only to add one additional measure: the unemployment indicator.

less for the level of religiosity for the top-25% of the education distribution. Interpreted in relation to religious coping, these highly educated individuals still cope religiously in response to earthquakes, though less than average. Interpreted in relation to religious coping, the explanation may be two-fold. First, more educated people are more informed in general and hence also about tectonic plates, which reduces the tendency for engaging religious attributions (the part of religious coping interpreting the earthquake as "an act of God"). Second, education may provide higher existential security as stressed by Norris & Inglehart (2011), which reduces the scope for all types of religious coping, e.g., gaining a closer relation to God or going to church to cope with the stress caused by the earthquake.

Columns (3) and (4) show that income does not seem to matter for how much people react to earthquake frequency in terms of religiosity. Column (5) shows that unemployed people do seem to react stronger to earthquakes in terms of elevated believing.[94] In fact, the religiosity of an unemployed person increases twice as much as an employed person in reaction to elevated earthquake risk. Last, marriage may also serve as bringing security in a persons life or can be interpreted as an extra coping mechanism; married people don't have to go to God to obtain comfort, which they can obtain from their spouse. Column (6) shows that married people seem to react less to earthquakes in terms of religious coping. In general, these results are consistent with the idea that individuals with more security in their lives or a larger range of available coping mechanisms refer less to religious coping when faced with stress.

Table A12. Religious coping depending on individual characteristics

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. var.: Strength of Religiosity Scale [0,1]						
Dist(earthq), 1000km	-0.067***	-0.067***	-0.050***	-0.060***	-0.058***	-0.068***
	(0.017)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)
Dist(earthq) x Education	0.001					
	(0.001)					
Dist(earthq) x Top 25% education		0.013**				
		(0.006)				
Dist(earthq) x Income			-0.000			
			(0.002)			
Dist(earthq) x Top 25% income				0.003		
				(0.009)		
Dist(earthq) x Unemployed					-0.037***	
					(0.008)	
Dist(earthq) x Married						0.013*
						(0.007)
Observations	97,787	97,976	70,825	93,810	100,315	103,281
R-squared	0.336	0.335	0.312	0.331	0.337	0.333
Baseline controls	Y	Y	Y	Y	Y	Y
Districts	580	580	469	585	586	591

[94]The unemployment dummy is equal to one if the person indicated his/her unemployment status as "Unemployed", zero otherwise. This is variable x028 in the pooled WVS/EVS.

Notes. OLS estimates. The unit of analysis is individuals surveyed in the pooled WVS / EVS. The dependent variable is the Strength of Religiosity Scale [0,1]. Dist(earthquake) measures the distance in 1000 km to the nearest high-intensity earthquake-zone (zones 3 or 4) as depicted in Figure 1. All controls from column (5), Table 2 included in all columns. In addition, all interaction models include both the interaction term and the particular variable individually. Variables described in the main text. The standard errors are clustered at the level of subnational districts. All columns include a constant. Asterisks ***, **, and * indicate significance at the 1, 5, and 10% level.

C Additional results for within districts analysis

C.1 Varying cutoff levels

The main earthquake measure for the within-district analysis defines a district as being hit by an earthquake if the closest earthquake hit within 100 km of the district borders. This cutoff was chosen to maximize the number of observations hit by an earthquake, at the same time as maximizing the potential impact of the earthquake on the level of religiosity in the particular district. Table A13 varies the cutoff level from 0 to 200 km. The correlation between earthquake distance and religiosity continues to be zero for cutoffs further away.

Table A13. Varying cutoff-levels

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent variable: D.Importance of God									
D.earthquakes	0.084***	0.069***	0.095***	0.087***	0.108***	0.083***	0.045*	0.040	0.031
	(0.024)	(0.013)	(0.028)	(0.030)	(0.028)	(0.013)	(0.024)	(0.027)	(0.025)
Observations	415	410	406	398	391	382	368	359	354
R-squared	0.460	0.460	0.467	0.466	0.473	0.463	0.452	0.448	0.447
Cutoff	0	25	50	75	100	125	150	175	200
District-years with earthquake	8	15	20	20	23	29	32	30	30

Notes. OLS estimates. The dependent variable is the change in the regional average of answers to the question "How important is God in your life?" (0="not at all important",..., 1="very important"). The unit of analysis is regions at different points in time. All regressions include all controls from column (3), Table 5. The standard errors are clustered at the country level. Asterisks ***, **, and * indicate significance at the 1, 5, and 10% level.

C.2 Additional religiosity measures

Table A14 reproduces Table 5 using instead the Strength of Religiosity Scale as measure of religiosity.

Table A14. First-difference estimation with different religiosity measure

	(1)	(2)	(3)	(4)
Dependent variable: Strength of Religiosity Scale				
Earthquake dummy	0.048**	0.078**	0.087**	0.060
	(0.020)	(0.037)	(0.039)	(0.034)
Observations	234	234	225	117
R-squared	0.396	0.403	0.437	0.412
Country-by-year FE	Y	Y	Y	Y
Baseline controls	N	Y	Y	Y
Indl controls	N	N	Y	Y
Inc and edu dummies	N	N	N	Y
Countries	20	20	20	11
Districts	175	175	173	107

Notes. The only difference to Table 5 is that the dependent variable is the change in the regional average of the Strength of Religiosity Scale.

C.3 Earthquake interactions

Column (2) of Table A15 includes the alternative earthquake dummy equal to one if one *or more* earthquakes hit the district in between two interview waves (the main earthquake dummy equals one if *one* earthquake hit, and is missing if more than one earthquakes hit). The estimate is unaltered. Column (3) shows that the precise number of earthquakes does not seem to matter for religiosity, which depends only on *whether* one or more earthquakes hit or not. This result should be taken with caution, as it could also be caused by the fact that very few districts are hit by more than one earthquake.

Columns (4), (5), and (6) and all columns in Appendix C.4 test the idea that religiosity increases in the immediate aftermath of the earthquake, only to fall back towards the long term level of religiosity after a while. The results in all columns are consistent with this idea, although without statistical significance.

The earthquake dummy is interacted with the period length in column (4). The interaction term is negative, although not statistically different from zero (p-value=0.165). Thus the smaller the window of observation, the larger the impact on religiosity, which we would expect as religiosity has had shorter time to fall back towards the long term level. The combined impact reaches zero when the window of observation is 12 years.

The earthquake dummy is interacted with years since the earthquake in column (5), showing that the impact of the earthquake shrinks over time, albeit not significantly. The years since last earthquake is measured with error, though, as it holds the value 100 for districts that were not hit by an earthquake since 1981. For the districts hit by an earthquake, the maximum years since an earthquake is 9 years. The combined impact of an earthquake that hit 9 years ago on religiosity i 0.058, which is not significantly different from zero. To account for the measurement error, the earthquake dummy is interacted in column (6) with a dummy equal to one if an earthquake hit last year, zero otherwise.

Column (7) and Table A16 investigate the surprise element of religious coping by interacting the earthquake dummy with a dummy equal to one if an earthquake hit in between the previous years. In consistence with the literature on religious coping, column (7) shows that the impact of an earthquake this period is smaller when an earthquake hit in the previous period, although the impact is not statistically different from zero.

Table A15. Religious coping dependent on earthquake characteristics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dep. var.: D.Importance of God							
Earthquake dummy	0.108***			0.244**	0.157**	0.111***	0.130**
	(0.028)			(0.112)	(0.075)	(0.032)	(0.048)
Earthquake dummy = 1 if one or more earthq		0.106***	0.101**				
		(0.026)	(0.040)				
Earthquake X Number earthquakes			0.004				
			(0.023)				
Earthquake X period length				-0.021			
				(0.015)			
Earthquake X years since last earthq					-0.011		
					(0.013)		
Earthquake X dummy for earthq last year						-0.012	
						(0.044)	
Earthquake X Earthquake t-1							-0.064
							(0.100)
Observations	391	400	400	391	391	391	381
R-squared	0.473	0.471	0.471	0.475	0.474	0.473	0.461
Baseline controls	Y	Y	Y	Y	Y	Y	Y
Sample	<=1 earthq	Full	Full	<=1 earthq	<=1 earthq	<=1 earthq	<=1 earthq

Notes. OLS estimates. The dependent variable is the change in the regional aggregate of answers to the question "How important is God in your life?" (0="not at all important",..., 1="very important"). The unit of analysis is subnational districts. All regressions include both interaction terms in addition to the list of standard controls: country-by-year FE, a measure of the number of years between the WVS/EVS waves, a measure of the years since the last earthquake, and individual controls for respondents' age, age squared, marital status, sex. All the individual-level controls are accounted for before aggregation to the district level. The standard errors are clustered at the country level. Asterisks ***, **, and * indicate significance at the 1, 5, and 10% level.

Table A16 interacts instead with the earthquake measure used in the cross-sectional study: distance to the nearest earthquake zone 3 or 4 (the highest intensity zones). The interaction term is positive throughout, showing that an earthquake striking districts located far from earthquake zones has a larger impact on religiosity compared to earthquakes hitting districts located in high-intensity earthquake zones. Or in other words; when the populace is not used to earthquakes, being hit by one generates larger response in terms of increased believing.

Table A16. Surprise earthquakes

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. var.	dimpgod	dimpgod	dimpgod	drel	drel	drel
Earthquake dummy	0.108***	0.108***	0.080***	0.087**	0.078*	0.078*
	(0.028)	(0.027)	(0.025)	(0.039)	(0.038)	(0.039)
Earthquake X Dist(earthq zones)		0.003	0.714***		0.172*	0.172
		(0.052)	(0.108)		(0.098)	(0.099)
Observations	391	391	317	225	225	169
R-squared	0.473	0.473	0.361	0.437	0.438	0.468
Baseline controls	Y	Y	Y	Y	Y	Y
Sample	full	full	<10 years	full	full	<10 years

Notes. OLS estimates. The dependent variable is the change in the regional aggregate of answers to the question "How important is God in your life?" (0="not at all important",..., 1="very important") (dimpgod) in columns (1)-(3) and the change in the Strength of Religiosity Scale (drel) in columns (4)-(6). The unit of analysis is subnational districts. All regressions include all controls from column (3) of Table 5. The standard errors are clustered at the country level. Asterisks ***, **, and * indicate significance at the 1, 5, and 10% level.

C.4 Alternative religiosity measures

Table A17 shows the main regressions for the individual measures of religiosity. Panel A shows the results corresponding to the specification in column (3) of Table 5. All religiosity measures are higher in districts hit by an earthquake compared to those not hit, although the only measure influenced significantly is answers to the question "How important is God in your life?" As the panel data is highly unbalanced with different districts measured in different intervals, panel B adds the interaction between the earthquake dummy and the length of the observation window. In line with the idea that religiosity increases in the immediate aftermath of the earthquake, only to fall back towards the long term level when stress relief has stepped in, the interaction term is negative throughout. Now also answers to "Do you find comfort in God?" and "Do you believe in God?" become significantly different from zero. The least influenced measure is answers to the question "How often do you go to attend religious services?", in line with the findings in the religious coping literature.

Table A17. Alternative religiosity measures

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dep. var.	drel	dimpgod	dcomfort	dbelieve	drel_pers	dafter	dservice
Panel A. Baseline regressions							
Earthquake dummy	0.087**	0.108***	0.033	0.022	0.049	0.127	0.030
	(0.039)	(0.028)	(0.039)	(0.015)	(0.044)	(0.094)	(0.040)
Observations	225	391	226	226	411	226	424
R-squared	0.437	0.473	0.273	0.392	0.514	0.412	0.530
Baseline indl controls	Y	Y	Y	Y	Y	Y	Y
Panel B. Allowing for differential effects across different observation windows							
Earthquake dummy	0.293***	0.244**	0.395**	0.091*	0.190	0.306	0.061
	(0.060)	(0.112)	(0.169)	(0.050)	(0.154)	(0.254)	(0.104)
Earthquake X period length	-0.033***	-0.021	-0.058**	-0.011	-0.022	-0.029	-0.005
	(0.008)	(0.015)	(0.023)	(0.007)	(0.022)	(0.041)	(0.012)
Observations	225	391	226	226	411	226	424
R-squared	0.441	0.475	0.280	0.392	0.515	0.414	0.530
Baseline indl controls	Y	Y	Y	Y	Y	Y	Y
Countries	20	36	20	20	36	20	36
Districts	173	281	173	173	288	173	301

Notes. OLS estimates. The dependent variable is the regional aggregate of the change in the Strength of Religiosity Scale (drel) in column (1) and each of the six components separately in columns (2)-(7): The change in answers to "How important is God in your life?" (dimpgod) in column (2), "Do you find comfort in God?" (dimpgod) in column (3), "Do you believe in God?" (dbelieve) in column (4), "Are you a religious person?" (drel_pers) in column (5), "Do you believe in Afterlife?" (dafter) in column (6), and "How often do you attend religious services?" (dservice) in column (7). The earthquake dummy is equal to one if one earthquake hit the district in between the interview waves, zero if no earthquake hit, and missing if more than one earthquake hit. The unit of analysis is subnational districts. All regressions include the list of standard controls from column (3) of Table 5. Panel B adds the interaction term between the earthquake dummy and the number of years in between interview waves. The standard errors are clustered at the country level. Asterisks ***, **, and * indicate significance at the 1, 5, and 10% level.

C.5 Across continents

Table A18 shows that earthquakes result in increased religiosity within all continents. The population of Oceania seem to react a bit more to earthquakes, while Europeans react more than average. Only 7 districts from Oceania are included in the sample, though, while Europe includes 111.

Table A18. Allowing for differential effects across continents

	(1)	(2)	(3)	(4)	(5)	(6)
Dep var: D.Importance of God						
Earthquake dummy	0.108***	0.109***	0.110***	0.099**	0.113***	0.104***
	(0.028)	(0.030)	(0.030)	(0.041)	(0.030)	(0.028)
Earthquake X Africa		-0.016				
		(0.036)				
Earthquake X America			-0.022			
			(0.036)			
Earthquake X Asia				0.011		
				(0.052)		
Earthquake X Oceania					-0.065*	
					(0.032)	
Earthquake X Europe						0.120***
						(0.034)
Observations	391	391	391	391	391	391
R-squared	0.473	0.473	0.473	0.473	0.474	0.474
Baseline controls	Y	Y	Y	Y	Y	Y

Notes. OLS estimates. The dependent variable is the change in the regional aggregate of answers to the question "How important is God in your life?" (0="not at all important",..., 1="very important"). The unit of analysis is subnational districts. All regressions include the list of standard controls from column (3) of Table 5. The standard errors are clustered at the country level. Asterisks ***, **, and * indicate significance at the 1, 5, and 10% level.