Magnitude vs Intensity
4-12

(Lisa Wald & Wendy Shindle, Oct 2001 (rev. Jul 2004)

Key Points:

-An earthquake has one magnitude, but many intensities

-The intensity of shaking generally decreases with distance from the hypocenter

-The intensity of shaking also is influenced greatly by the type of underlying material – soft sediments shake more than hard rock

-Earthquake magnitude is quantitative and exact and is a measurement of the size of the earthquake – it is expressed as a number; intensity is qualitative and more subjective and is a measurement of the earthquake effects – it is expressed as a Roman numeral

-The Modified Mercalli Intensity Scale is what we use in the U.S. Other countries use other scales.

Procedure:

Give each student the handout of the zipcode map and a copy of the Modified Mercalli Scale. Then each student gets a different "earthquake experience" paragraph for an individual zipcode. There are 30 earthquake experiences for each of the 30 designated areas on the map. Discuss the difference between the magnitude of the earthquake and the intensities of shaking caused by the earthquake.

Each student reads the description of their earthquake experience in their zipcode to the class, and using the Modified Mercalli Scale, each student in the class determines what they think the intensity is for that zipcode.

Students will then color in the key at the bottom of the map using their own color key, and then color in each zipcode according to the intensity they have assigned based on the description.

Then show the class the real intensity map for the earthquake and compare all the maps. Discuss how well the intensities were determined, why they may have been assigned differently by different people. Discuss the color keys chosen by the students and why some work better than others in depicting the intensity pattern. Last discuss the pattern of intensities, and why it looks the way it does. What contributes to the intensity of shaking that is felt in different areas?

Reiterate that the earthquake magnitude is one number no matter where you are, and the intensities are different for different locations.

Notes:

See the Modified Mercalli Intensity Scale below.

Modified Mercalli Intensity Scale

I. Not felt. Marginal and long period effects of large earthquakes.

II. Felt by persons at rest, on upper floors, or favorably placed.

III. Felt indoors. Hanging objects swing. Vibration like passing of light trucks. Duration estimated. May not be recognized as an earthquake.

IV. Hanging objects swing. Vibration like passing of heavy trucks; or sensation of a jolt like a heavy ball striking the walls. Standing motor cars rock. Windows, dishes, doors rattle. Glasses clink. Crockery clashes. In the upper range of IV, wooden walls and frame creak.

V. Felt outdoors; direction estimated. Sleepers wakened. Liquids disturbed, some spilled. Small unstable objects displaced or upset. Doors swing, close, open. Shutters, pictures move. Pendulum clocks stop, start, change rate.

VI. Felt by all. Many frightened and run outdoors. Persons walk unsteadily. Windows, dishes, glassware broken. Knickknacks, books, etc., off shelves. Pictures off walls.

Furniture moved or overturned. Weak plaster and masonry D cracked. Small bells ring (church, school). Trees, bushes shaken (visibly, or heard to rustle).

VII. Difficult to stand. Noticed by drivers of motor cars. Hanging objects quiver. Furniture broken. Damage to masonry D, including cracks. Weak chimneys broken at roof line. Fall of plaster, loose bricks, stones, tiles, cornices (also unbraced parapets and architectural ornaments). Some cracks in masonry C. Waves on ponds; water turbid with mud. Small slides and caving in along sand or gravel banks. Large bells ring. Concrete irrigation ditches damaged.

VIII. Steering of motor cars affected. Damage to masonry C; partial collapse. Some damage to masonry B; none to masonry A. Fall of stucco and some masonry walls. Twisting, fall of chimneys, factory stacks, monuments, towers, elevated tanks. Frame houses moved on foundations if not bolted down; loose panel walls thrown out. Decayed piling broken off. Branches broken from trees. Changes in flow or temperature of springs and wells. Cracks in wet ground and on steep slopes.

IX. General panic. Masonry D destroyed; masonry C heavily damaged, sometimes with complete collapse; masonry B seriously damaged. (General damage to foundations.) Frame structures, if not bolted, shifted off foundations. Frames racked. Serious damage to reservoirs. Underground pipes broken. Conspicuous cracks in ground. In alluvial areas sand and mud ejected, earthquake fountains, sand craters.

X. Most masonry and frame structures destroyed with their foundations. Some well-built wooden structures and bridges destroyed. Serious damage to dams, dikes, embankments. Large landslides. Water thrown on banks of canals, rivers, lakes, etc. Sand and mud shifted horizontally on beaches and flat land. Rails bent slightly. Rails bent greatly. Underground pipelines completely out of service. Damage nearly total. Large rock masses displaced. Lines of sight and level distorted. Objects thrown into the air.

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USGS Community Internet Intensity Map for Northridge (JAN 17 1994) Magnitude 6.7

INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+
SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy

Color the Intensity Scale at the bottom of the map first with a different color for each intensity. Then color in the map to reveal which areas had the most shaking in the Northridge earthquake
Small zipcode areas have been combined in many cases and represented by one zipcode. The resulting ShakeMap in this exercise is representative of the actual shaking distribution, but not exactly accurate for each individual zipcode.

Earthquake Experiences Narratives

93065, 91362, 91367--I was driving home from work and it felt like I had a flat tire. I pulled off the road to check and as I stopped the car I saw the chimney on a nearby house collapse. It fell right on a new Lexus that was parked in the driveway.

93012, 91301, 91361, 91360, 93033, 93004, 93021, 93010, 91320-- I had just gotten up to give my baby daughter her bottle when I felt a violent jolt. I knew we were having an earthquake so I tried to run into her room to get her but it was so hard to walk! I could hear things outside falling and hitting the ground, and all of the pictures in the hall were falling and breaking. I was so scared!

90248--I am a nurse at a local hospital. I was attending to Mr. Jones when I first felt the earthquake. He woke up and we watched a glass of juice on his bedside table slide back and forth-I caught it before it tipped. Most of the patients woke up-let me tell you, it was a long night!

90265--My parents were out of town visiting my brother at college so my best friend John and I decided to have a party. The party was pretty much over and we were doing damage control in the back yard when I felt something weird. I thought it was just me but then everything started to shake. I mean, even the pool had waves in it and the water was spilling out over the edges! And so much stuff in the house had fallen over and broken you couldn't even tell we had a party!

91387--I work the late shift at Denny's. I was outside on my break when I felt the first shake. Then everything started shaking so hard I could even hear the bushes rattling! The people inside felt it too. Their plates and glasses were shaking and bouncing and a bunch of them came running outside. I don't know where they thought they were going to go, it was shaking outside too!

93510--I am from Virginia and I was in California visiting my grandchildren. In the very middle of the night I woke up and felt a strange rumbling. Then things started to shake a bit and my grandson ran into my room and told me to stand in the doorway, that we were having an earthquake. Well, that door was swinging back and forth and I told him that I would stay right where I was thank you very much! I wasn't going to get knocked out by some door and have to be taken to the hospital in my nightclothes!

91706--I am a really heavy sleeper and I didn't even wake up, but my husband was up getting a snack and he said he felt it. He said the dishes in the cupboard rattled and he could see the hanging plants swaying.

91042--I am a seismologist with the USGS and my first thought when I felt the earthquake was "I'm going to work tonight!" My husband and I watched as several picture frames slide off the mantle, and then we ducked under the table. We had to hold on because the table was trying to slide away. Lots of our dishes were broken and we have a lot of cracks in the walls to fix.

90016--I was sleeping soundly when I was suddenly thrown out of bed. I could hear my kids crying and I was trying to run, trying to get to them. The walls were shaking and

cracking and pieces of plaster were falling from the ceiling. I could barely stand. The noise was deafening. By the time I got to my kids and got them outside the whole thing was over. We have a lot of damage to our house but not as much as our neighbors. Their house partially collapsed.

91331--I'm a night watchman at an apartment complex. It was pretty late and everything was real quiet. I was making my rounds when I felt a strong jolt-it almost knocked me off my feet! I ran out into the middle of the street and it's a good thing I did too! Bricks were falling off of the building and the trees were shaking so hard that branches were breaking and falling off. All of the parked cars around me were shaking and bouncing and the car alarms were all going off.

91384--My daughter had just arrived home (WAY past her curfew) and we were arguing in the den. When we felt the shaking we just stared at each other. The sound of a glass smashing snapped us out of it. We both ran to the China hutch where I keep my mother's china-it was just about to tip over! We held it up and we could hear other things around the house falling and breaking. Needless to say I wasn't worried about the curfew violation any more!

93015--I was up late working on a briefing when I first felt the earthquake. It didn't seem too bad at first so I stayed put to see if it would get worse. It did! I tried to get up and could barely stand. I remembered that your supposed to get under a table if it's a bad earthquake so I got down on my hands and knees and crawled under my table. Just as I got under there my big bookcase fell and smashed on the table. If I had still been sitting there it would have crushed me.

93543--We were out of town when the earthquake hit. Of course, we were scared for our friends and family and for our home. We called our son and he said that everyone was alright, but they had a lot of structural damage to their house, and had lost some personal items. We called the neighbors and they gave us a grocery list of damage to our house-chimney broken at the roofline, cracks in the masonry, fallen bricks, stuff like that. I'm afraid to go home and see the damage inside.

93532, 93243, 93536--My husband woke me up yelling that we were having an earthquake. As we ran in to the kitchen I could hear the plates and cups banging and rattling, and all of the pictures were falling off the walls. We grabbed the dog and all got under the table. I knew we were going to be alright because our house is retrofitted and all of our things are secured, but I was worried about my mom and dad.

93060, 93023--I was asleep when the earthquake came. I was so scared and I didn't know what to do. The house was shaking so bad that I couldn't even walk. My dad came into my room and got me and we got under the table. We could see the refrigerator sliding back and forth across the kitchen with its door opening and shutting and all of the stuff falling out onto the floor. Our TV went flying across the room and smashed into the wall. All over we could hear things breaking. Then the lights went out. After it stopped and we went outside we could see all of the other people outside too. They were crying and looking around. Part of our apartment building fell down and now those people have to find another place to live. We might have to too.

93591--I was just finishing a great Tom Clancy novel when I felt the earthquake. At first I thought it was a passing truck but then I noticed that the blinds were swinging a little bit. I thought about calling my buddy to see if he had felt it but it was late and I was pretty sure it wouldn't have woken him up.

93551, 93534--I was sleeping over at my friend's house when the earthquake came. We were supposed to be asleep but we were telling stories so we felt it first. She said that her family had an earthquake plan and we were supposed to go into the dining room and get under the table. It was kind of scary because all of the furniture was moving around and her dad's computer fell on the floor and broke, but I wasn't really scared because her mom and her dad said that we were prepared and we'd be okay.

91377, 91301—I was driving home from my late shift when it felt like the car wasn't driving normally. Then I noticed dirt sliding down the steep side of the ditch next to the road. I stopped the car on the side of the road and got out. That's when I noticed the new cracks in the concrete wall on the other side of the ditch. By that time the shaking had stopped, so I got back in my car and drove home.

93552, 93535, 93550—I was working on my computer when the earthquake struck, and it was scary. My desk chair was rolling back and forth across the floor, and all the pictures fell off the bookshelves. My computer almost fell off the table too!

91342—I had fallen asleep watching TV when I felt a tremendous jolt. Things were things flying through the air and I ran to get under cover. There was a huge crash and part of my ceiling fell in. My chimney had collapsed!

91302—It was exam week and I was coming home late from the library when I felt the shaking. I had to run into the middle of the street to get away from the tree branches. They were breaking off and falling all around me!

90404—I was out of town for the earthquake, but my neighbor says our house has sustained a lot of damage. It fell off the foundation. I guess we shouldn't have put off that retrofitting.

93066—I thought the earthquake was great! What a ride! Our panel walls fell down, and we have some damage to the masonry, but it was such a fun experience! I can't wait to tell my friends back east!

91350—I'm a bus driver on the graveyard shift. I thought I must have blown out a tire because it was so hard to drive. I pulled over to the side of the road and turned my head just in time to watch the old factory tower fall down!

91390—Our big surprise from this earthquake was the next morning when we went outside and saw big cracks in the hillside behind our home. Scary!

90240—My wife woke me up and asked me if I felt anything. I told her the only thing that I felt was her shaking me! She said she thought we were having an earthquake, and when I stopped and listened I could hear the glasses in the kitchen rattling and clinking. There was an earthquake-and a pretty big one! Who knew?

93553—I was sleeping when I felt the first jolt. I got out of bed but it was hard to stand. I was amazed by all the noise-car alarms were going off, things were falling and breaking, and the church bells across the street were even ringing! Can you imagine? Those things are huge!

91403—I had just gotten up to go to the bathroom when the earthquake came. It was unbelievable. It threw me off my feet. My roommate and I ran to get underneath the dining room table. As I was running I saw my computer flying through the air. Once we got under the table we held on for dear life! It felt like it lasted forever but really it was only a few seconds. Once it stopped we went outside and saw the mess. Pipes had broken and everything was flooding, there were little sand volcanoes in the front yard. There was lots of damage to peoples houses and chimney's but everyone on our block was uninjured. It was the most frightening experience of my life.

93063—I was at a soccer game when the ground started shaking really hard. Our whole team was really scared, and most of us sort of fell to the ground because it was so hard to stand up. It was really weird when some sand sprayed up from a couple of places in the field. When the shaking stopped, we saw some of the houses on the street looking lopsided, with collapsed porches. There was even one that had collapsed!

Central & South LA--I was asleep in my tent when I felt the earthquake. It woke up my whole family, and all of the other campers in the campground. Since there were no rocks, trees or buildings around we all felt pretty safe. It was a thrilling way to experience the power of nature.

I was making dinner for me and my friends when the ground started shaking. The chandelier was swaying, and one of the lamps fell off the table and broke. There wasn't any expensive damage, but it was a day I will never forget.

I was on a picnic when we thought we heard a small animal in the bushes shaking them. But then when we walked over to the bushes, it felt funny walking. When some of the things fell over on the picnic table, we finally realized it was an earthquake.

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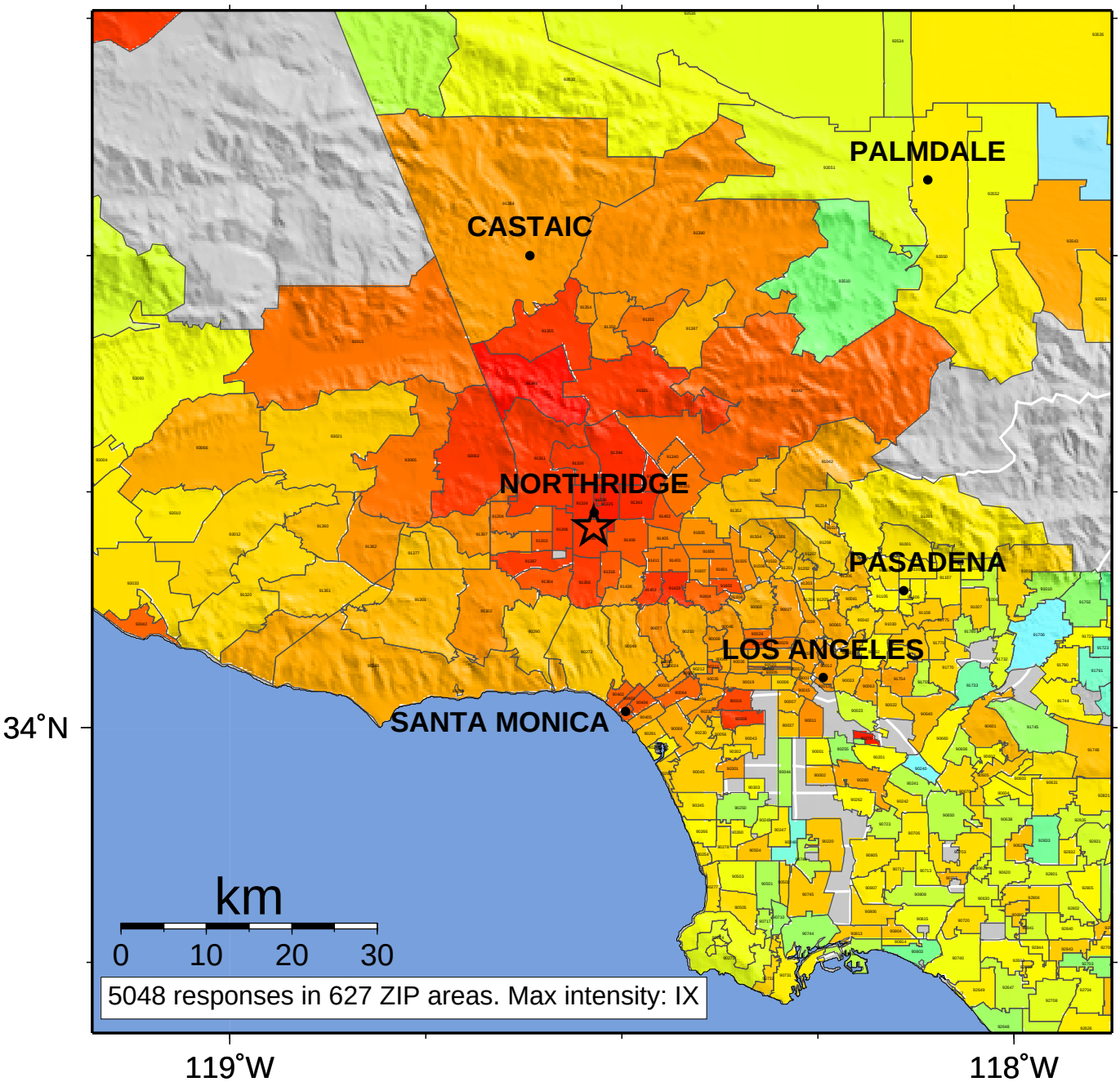
The magnitude of an earthquake is the same no matter where you are.
The shaking intensity, however, changes from place to place.

USGS Community Internet Intensity Map for Northridge (JAN 17 1994)

04:30:55 PST Mag=6.7 Latitude=N34.21 Longitude=W118.54



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