The Quake-Catcher Network

震动捕捉网

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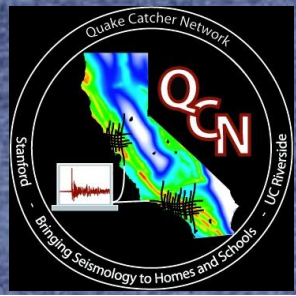
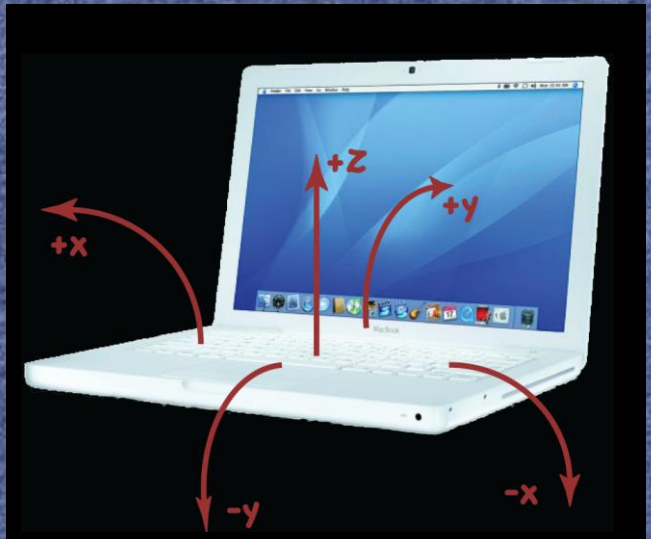
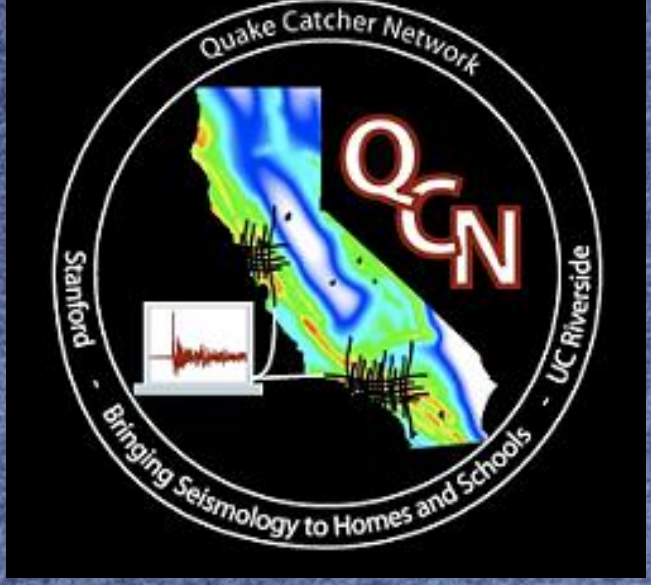


Quake-Catcher Network

http://qcn.stanford.edu

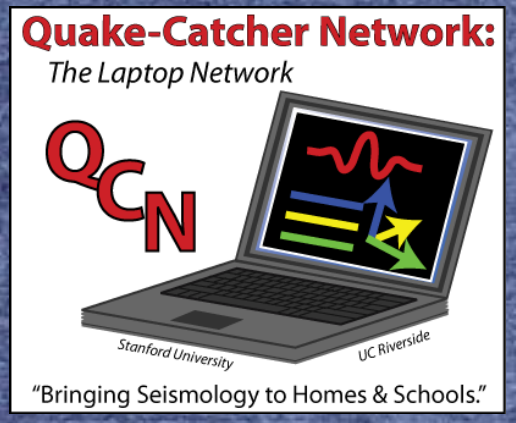
- **Network computers** for rapid earthquake detection.
- 通过计算机网络快速探测地震
- **Volunteer computing** to monitor sensors
- 通过志愿计算监控遥感器
- Potential for low-cost early warning systems
- 廉价的早期预警系统
- educational initiatives i.e. Citizen Cyberscience
- 教育倡议，如大众科学





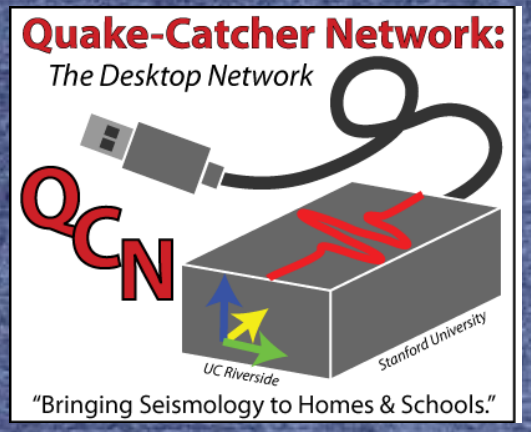
QCN: Laptop Network 笔记本网络

- Laptops With Sensors:
- 笔记本上接上遥感器
- HP, Apple, ThinkPad, Acer
- 适用任何型号的笔记本，HP，Apple..
- Very noisy data, not coupled to ground
- 数据嘈杂，设备没有固定在地面上
- Sensors move location – track online
- 遥感器的位置不断变化－在线追踪



QCN: Desktop Network 台式机网络

- Desktops with connected USB sensors
- 在台式机上接上USB接口的遥感器
- Cost: US $35-$150 per sensor
- 遥感器价格：35－150美元 / 个
- In noisy environments (homes & businesses)
- 置于嘈杂的环境众（家 / 商业场所）
- Over time hardware is getting cheaper, sensitivity/features are increasing
- 越往后，硬件越来越便宜，遥感器的灵敏度也越来越高，特性也越多。



Desktop Network台式机网络

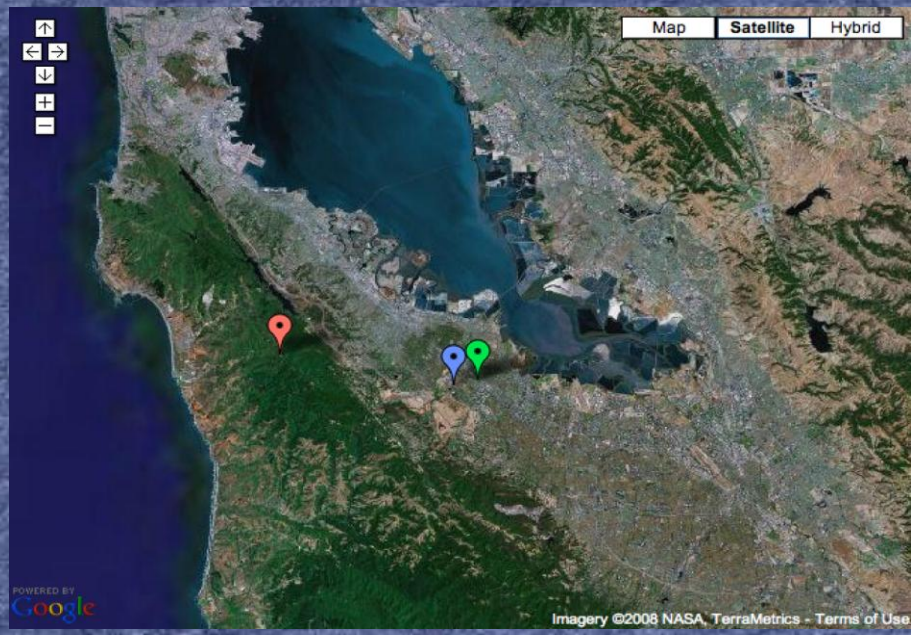
- With a USB sensor, any computer can be turned into a strong motion seismometer with QCN software
- 装上USB遥感器和QCN的软件后，任何一个台式机都可以变成一个地震仪。
- Soon (1 month) we'll have more advanced 16 & 24-bit sensors (currently 8 & 14-bit sensitivity)
- 不久（一个月之内），我们将采用更高精度的遥感器（16&24比特），当前采用的是8&14比特的遥感器

Location定位

3-step Location System:

三步定位系统：

- Estimate location based on last known router (geoip)
- 根据上次已知的路由信息(geoip服务，通过IP地址定位经纬度)，估计位置
- Or participants provide their “favorite five locations”
- 或者参与者提供他们最喜欢的5个位置
- linked to IP address or set a default location
- 将实际地址与IP地址链接起来，或者设置一个缺省的位置



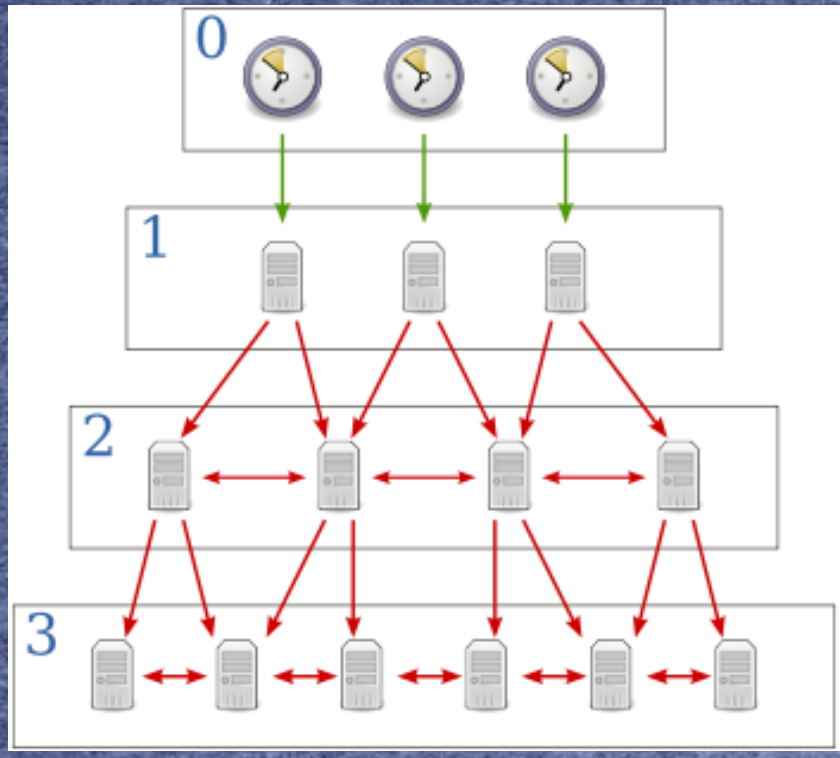
Select	Location Name (optional)	Latitude	Longitude	Net (IP) Addr	Set Net Addr	Clear Net Addr
	Home	34.0971731803043	-117.72793114185	76.170.119	Set Current	Clear
	Work	33.9745572764349	-117.32615232467	138.23.128	Set Current	Clear
					Set Current	Clear
					Set Current	Clear
					Set Current	Clear
	Update info					

Battling Noise 剔除噪音

- Algorithm self-adjusts to noise level
- 算法能根据噪音程度自调节
- Only monitor when laptop unused / idle
- 仅在电脑闲置的时候进入震动监控状态
- Use 1,000s-100,000s sensors, not 10s-100s
- 数据采样来自1000—10万个遥感器，不是10个或者100个，具有普遍性


Timing 时间同步

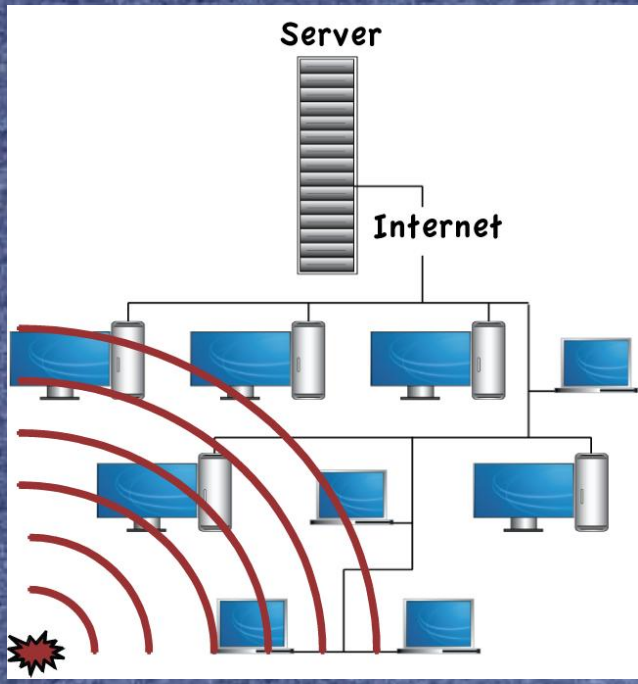
- Network Time Protocol (NTP, 1985)
- 网络时间同步协议（NTP 1985）
- Client connects to QCN servers to get an offset adjustment
- 客户端连接到QCN的服务器调整时间偏差



http://en.wikipedia.org/wiki/Network_Time_Protocol

Earthquake Detection地震判断

- When the QCN receives many triggers from a region (as little as 6-8)
- 当QCN从同一个区域的大量客户端接收到触发
- Otherwise just people bumping their laptops
- 否则可能仅仅是有人在晃自己的电脑
- For big earthquakes:
- 对于大地震：
  - only strong vibrations will be detected
  - 只有强烈的震动才被遥感器探测到
  - Only large earthquakes will cause consistent triggers across a region of the network
  - 只有大地震才能引发同一个区域网上的持续触发

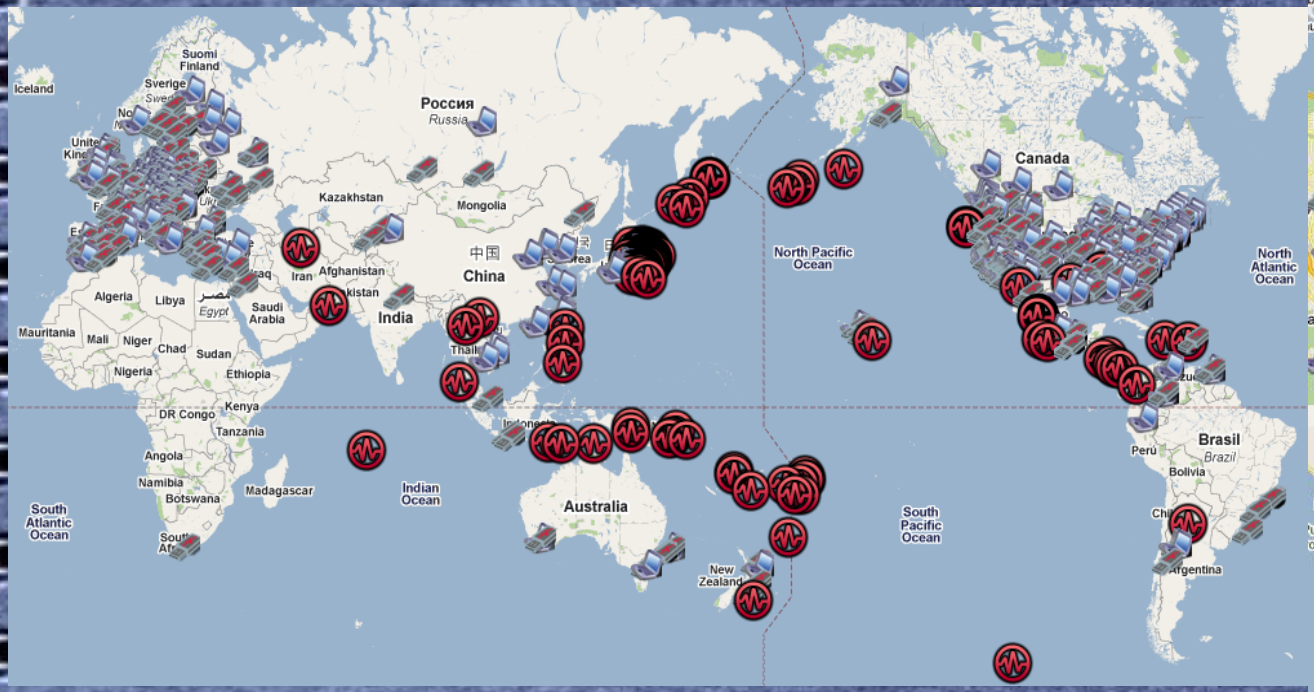


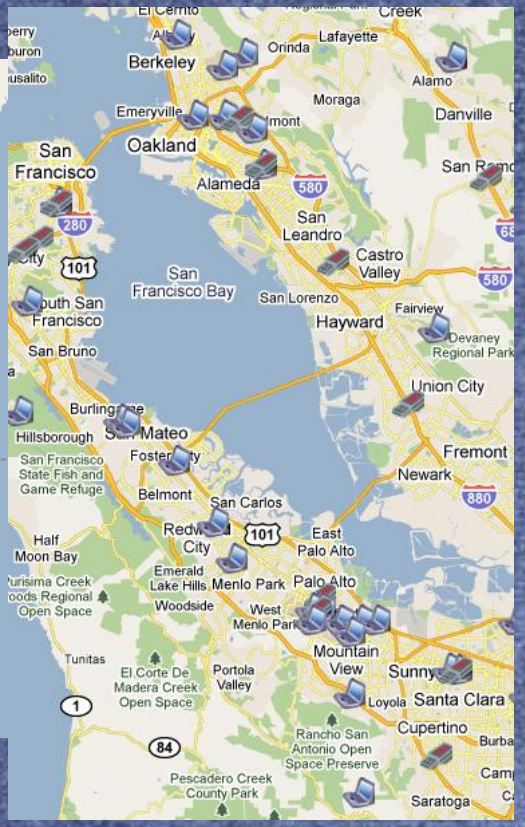
Rapid Response 迅速响应

- Use a fast triggering algorithm
- 采用一个快速触发算法
- Transfer statistics, not waveforms
- 传输统计信息，而不是地震波形式的信息
- Small XML "packet" that the BOINC client sends up instantly – full file uploaded later as needed
- BOINC客户端将短小的xml信息报立即反馈给QCN服务器，完整的文件可在以后有需要的时候再传输

Network Status ~1400 (03/2011)

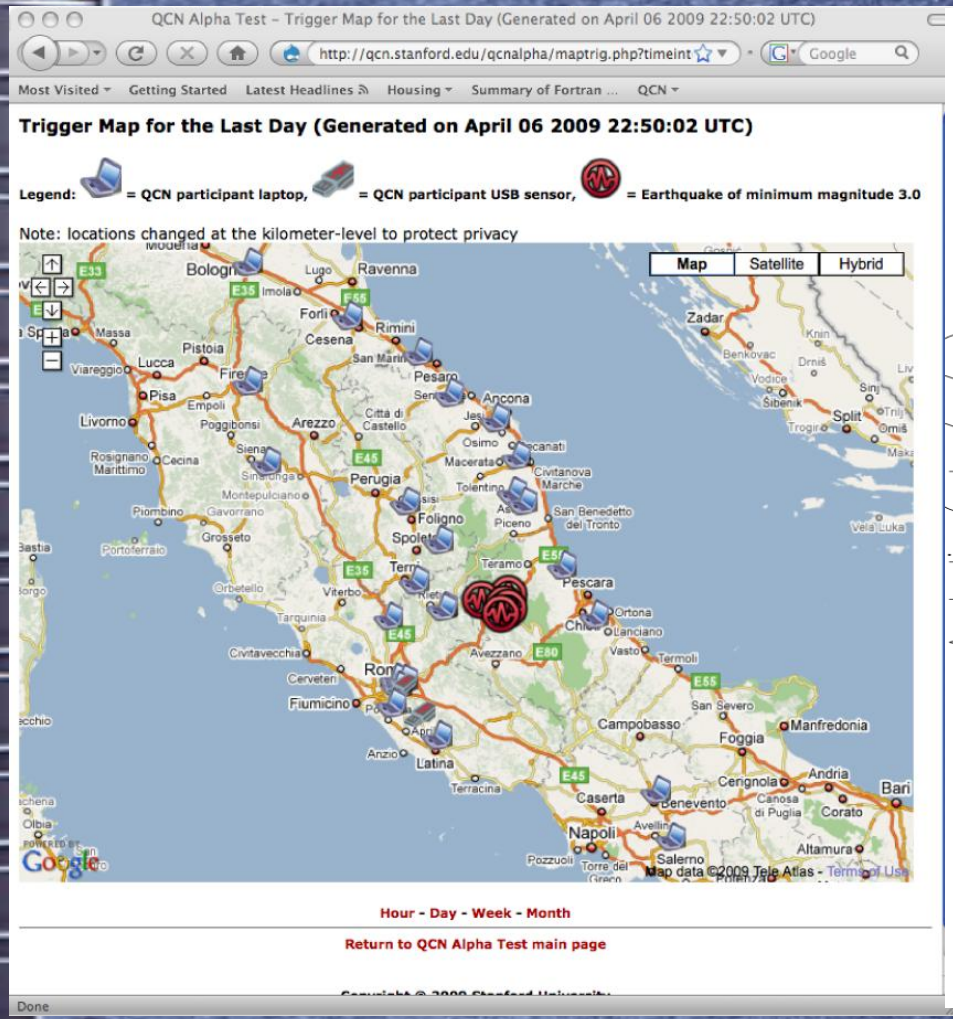
网络状态 ~1400（03/2011）

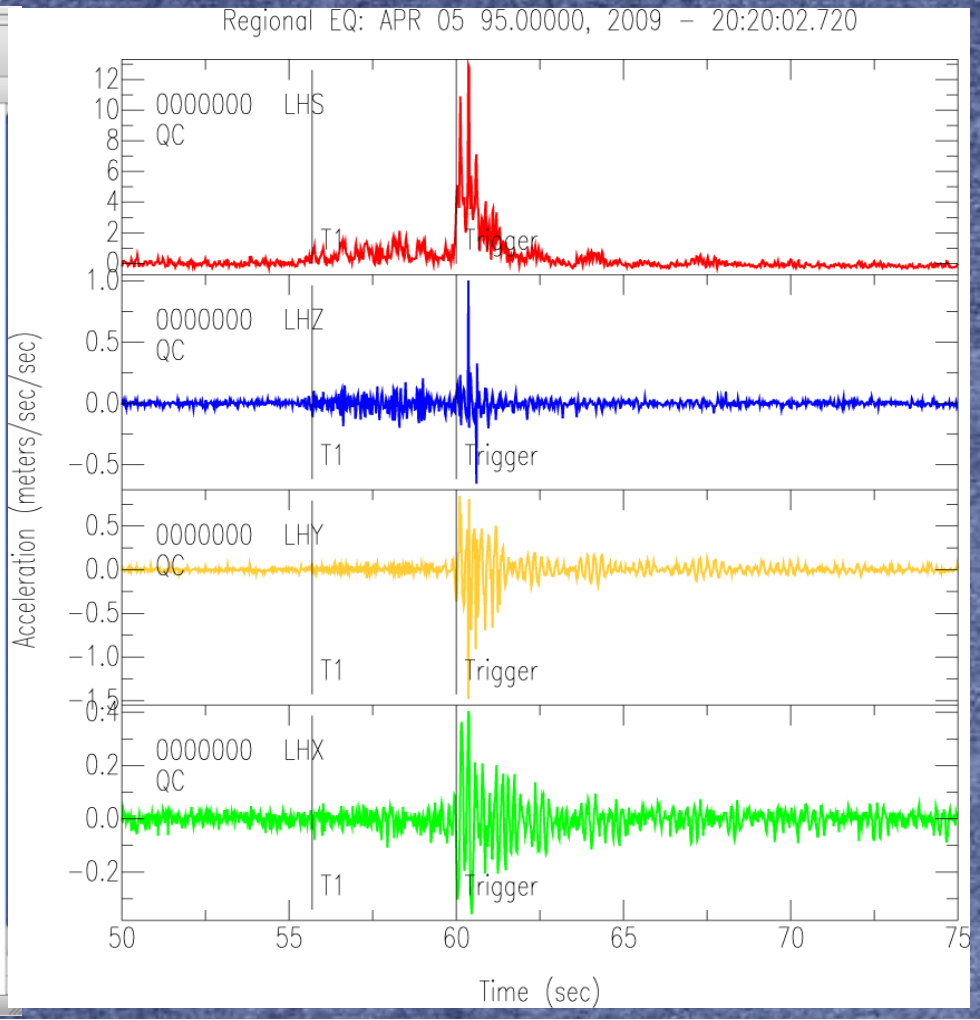




Italy 04/2009 – 3 sensors

意大利2009年4月3个遥感器

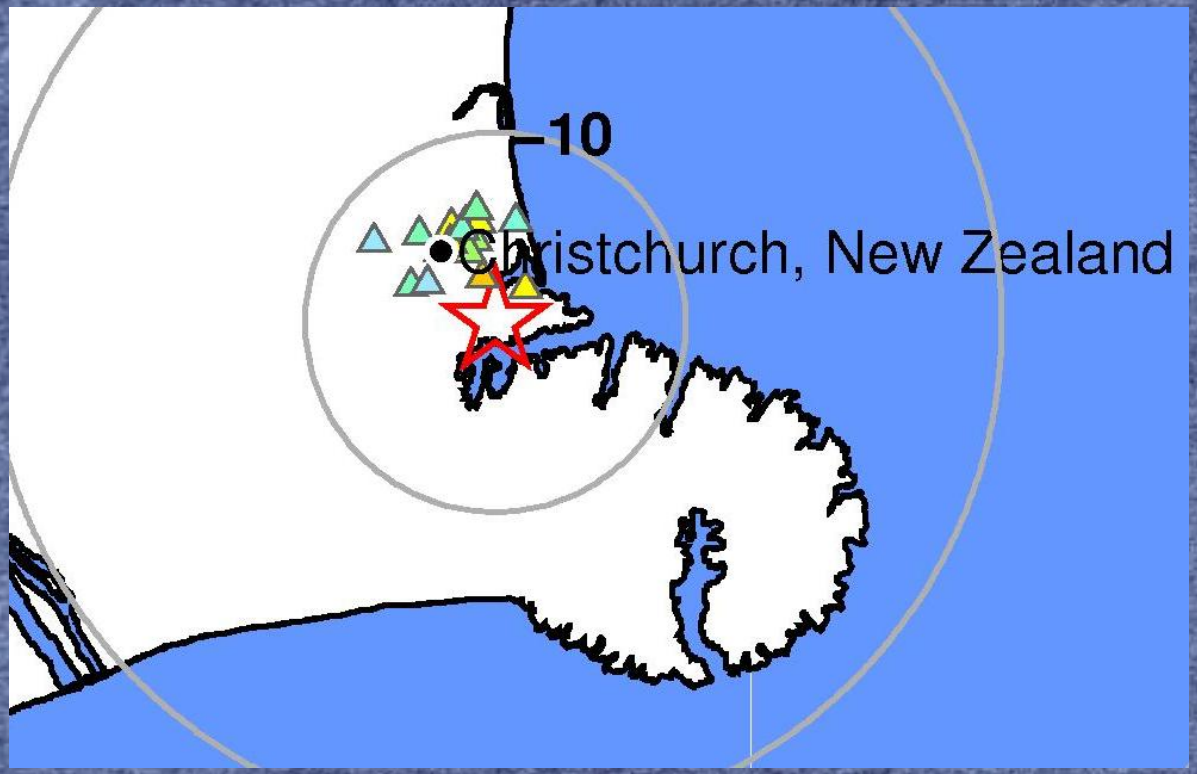




Christchurch NZ 03/14/2011

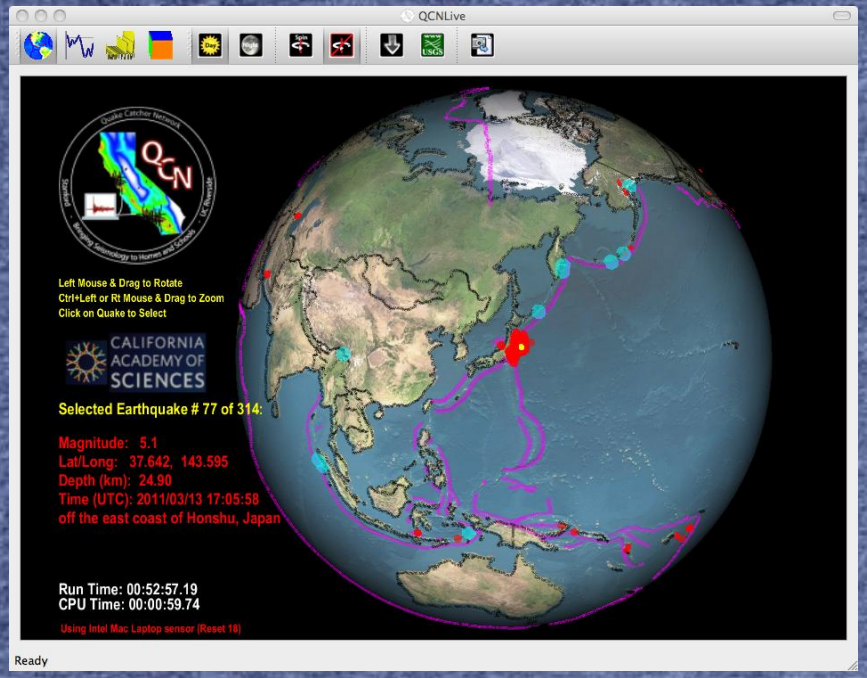
March 14th 2011 07:29:28
22 USB Sensors
172.70, -43.59

QCN students/postdocs
Installed ~100 USB sensors
In Christchurch after the
Major quake few months ago



Educational Outreach教育外展

- What we provide:
- 我们提供：
  - QCNLive software
  - QCNLive软件包
  - Seismology related in-class activities.
  - 地震仪相关的课间活动
  - Classroom USB Sensor.
  - 教室USB遥感器
  - Classroom BOINC Software.
  - 教室BOINC软件



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