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RESEARCH FOR GRAND CHALLENGES

The role of Sensors (network) in Earthquake Early Warning and Rapid Response applications

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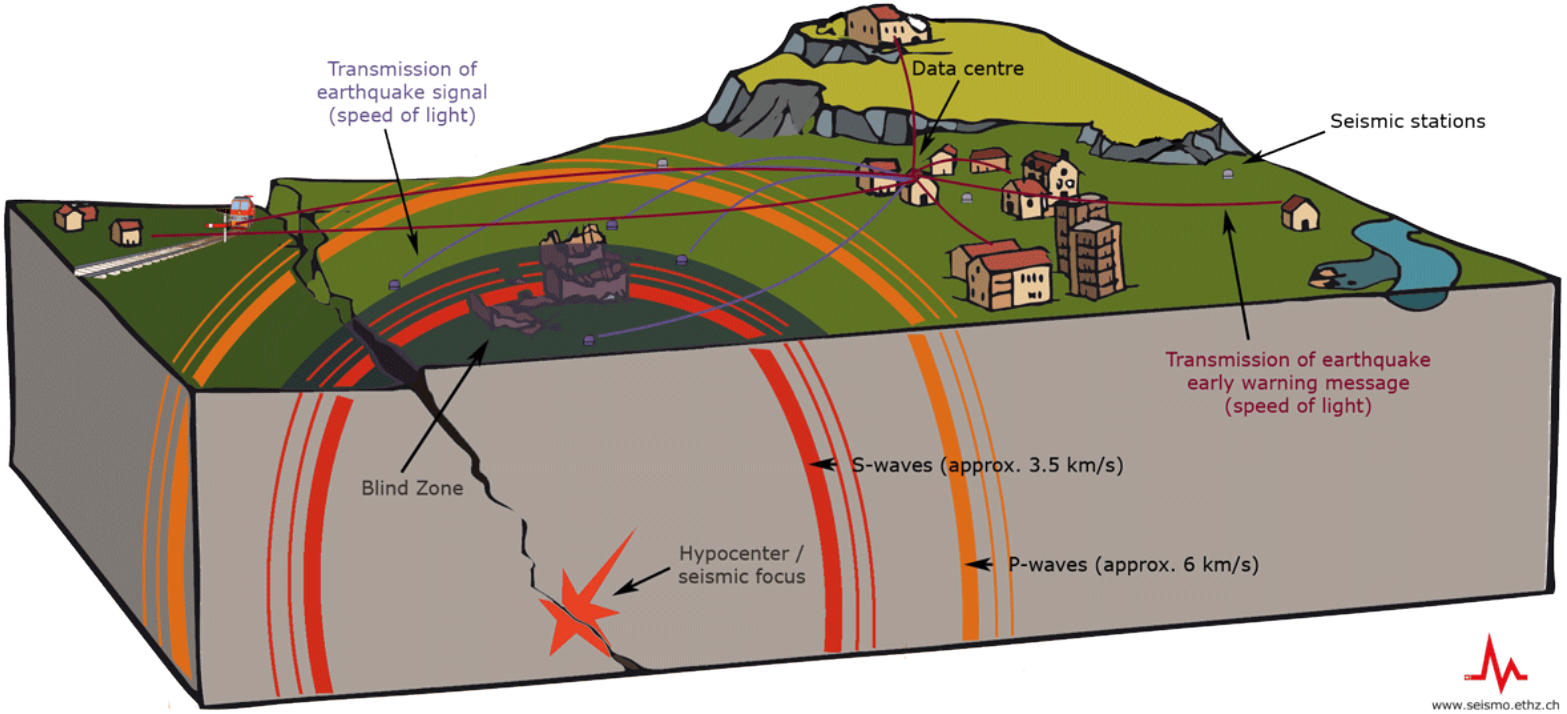
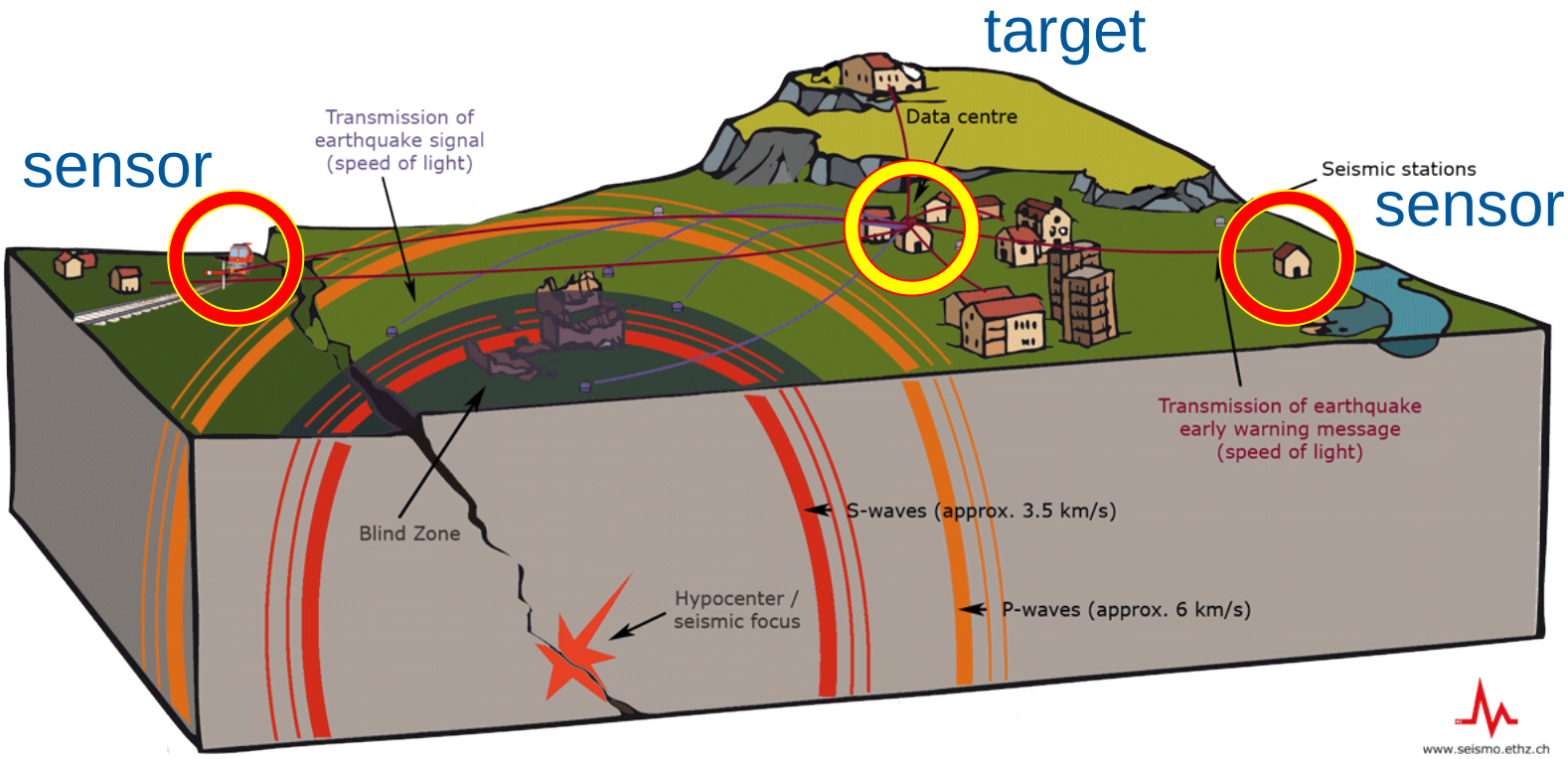
and the crew of the "Early Warning and Impact Assessment Group"
GFZ-Potsdam

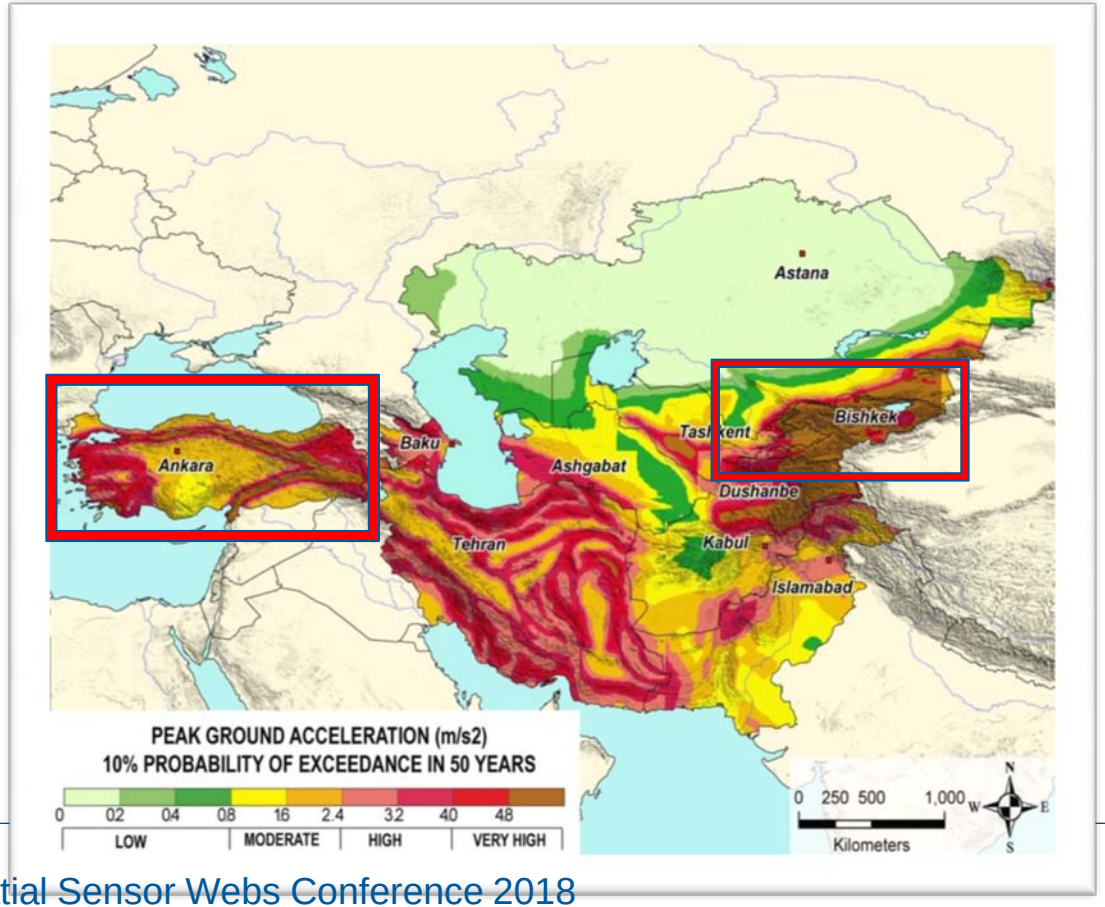
Earthquake **Early Warning** and Rapid Response



Earthquake **Early Warning** and Rapid Response

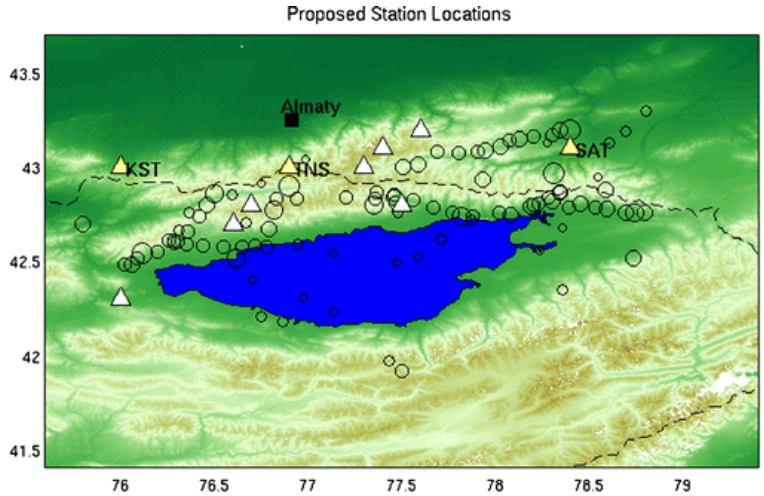


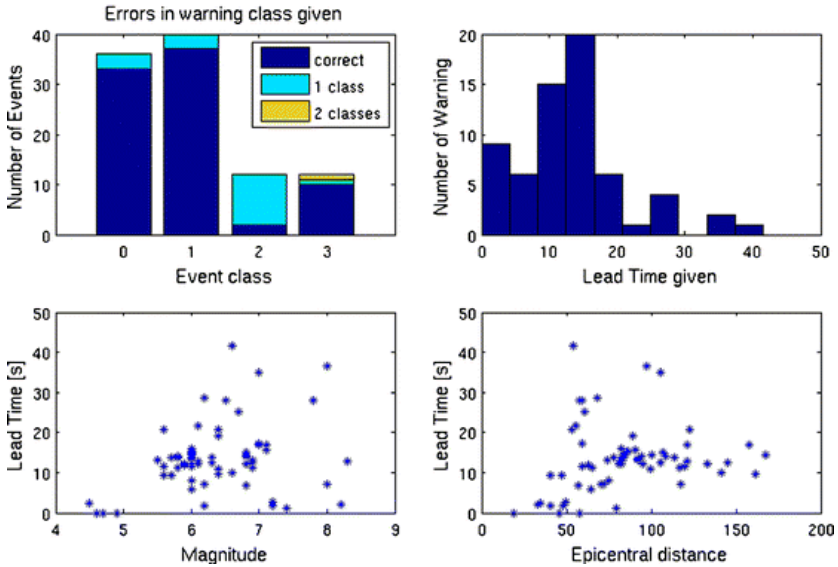
Test applications: **Turkey** and **Kyrgyzstan**



GSHAP (1999)

ACROSS - Network optimization





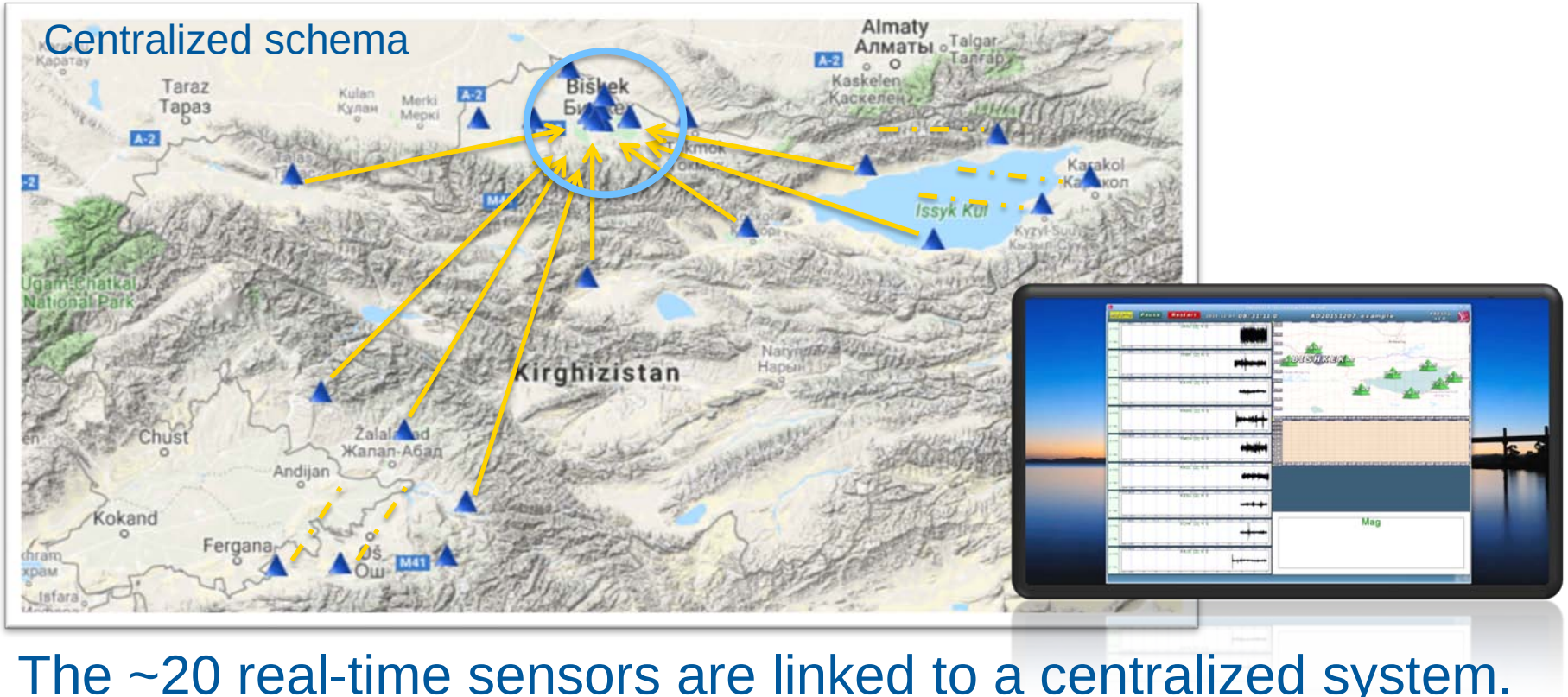
Performance-based optimization based on statistical learning

Stankiewicz et al., 2015

ACROSS – Strong Motion Network

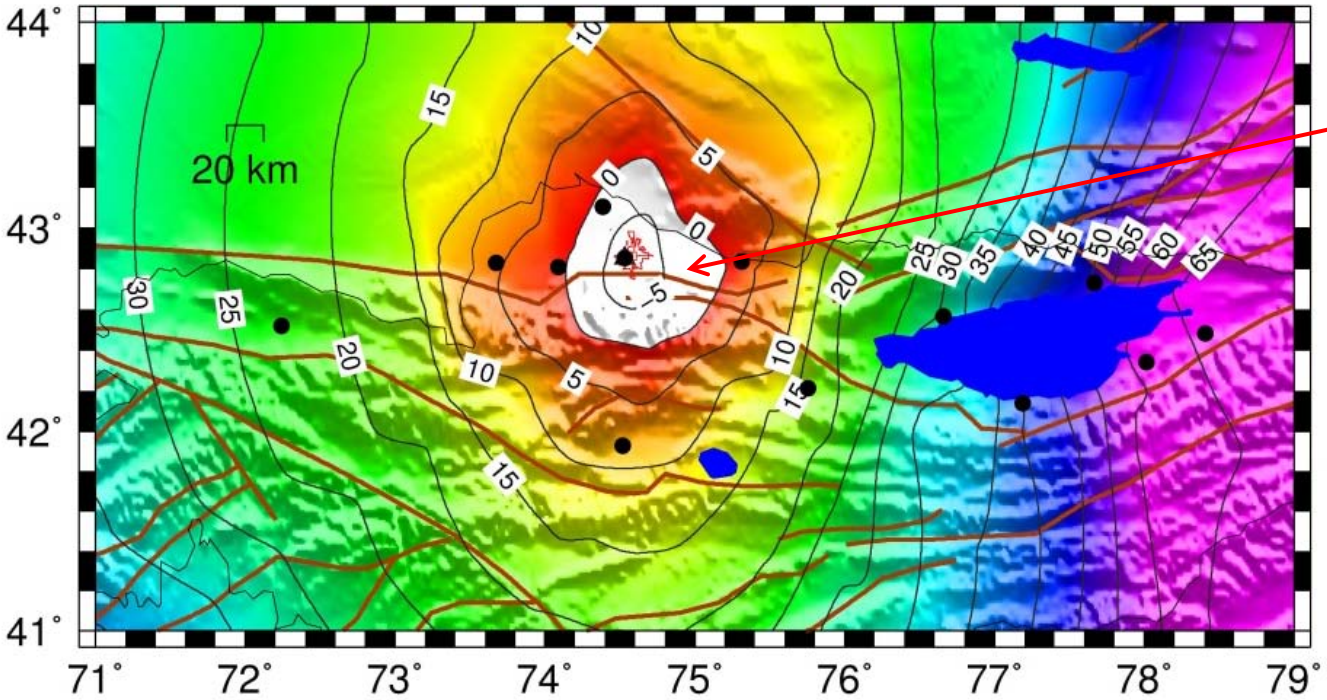
Network geometry has been optimized for EEW applications

The Kyrgyzstan **Regional Early Warning** System



The ~20 real-time sensors are linked to a centralized system.

Performance of regional EEW Systems



„blind“ zone

Parolai et al., 2017

Geospatial Sensor Webs Conference 2018

Custom **sensor node** development

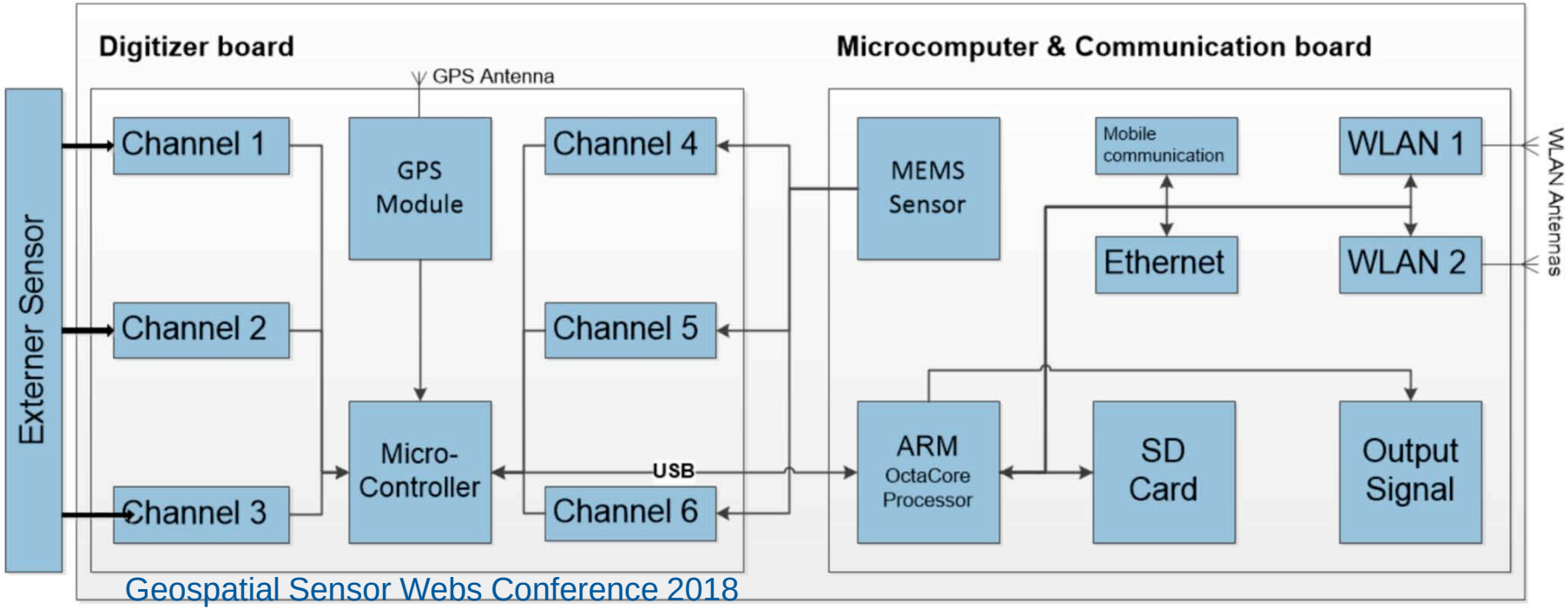
MP (Multi-Parameter) wise

Battery and power mngm.

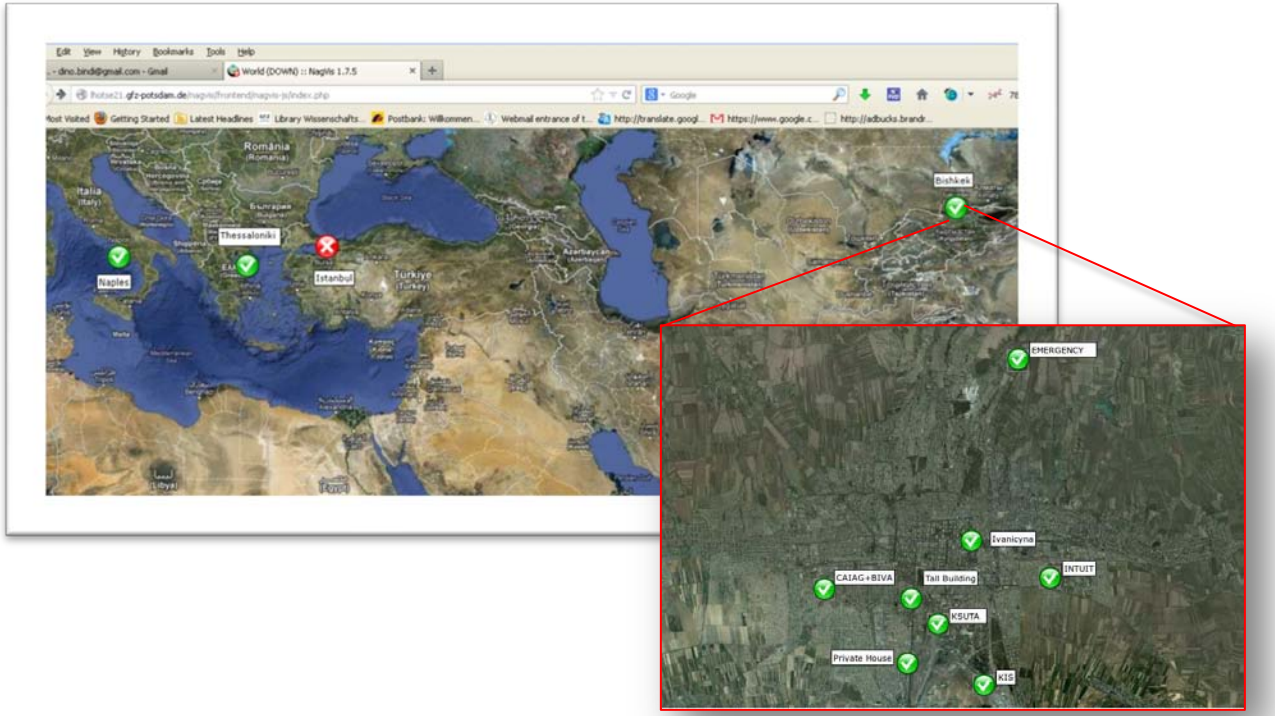
Sensor node

Custom **sensor node** development

MP (Multi-Parameter) wise



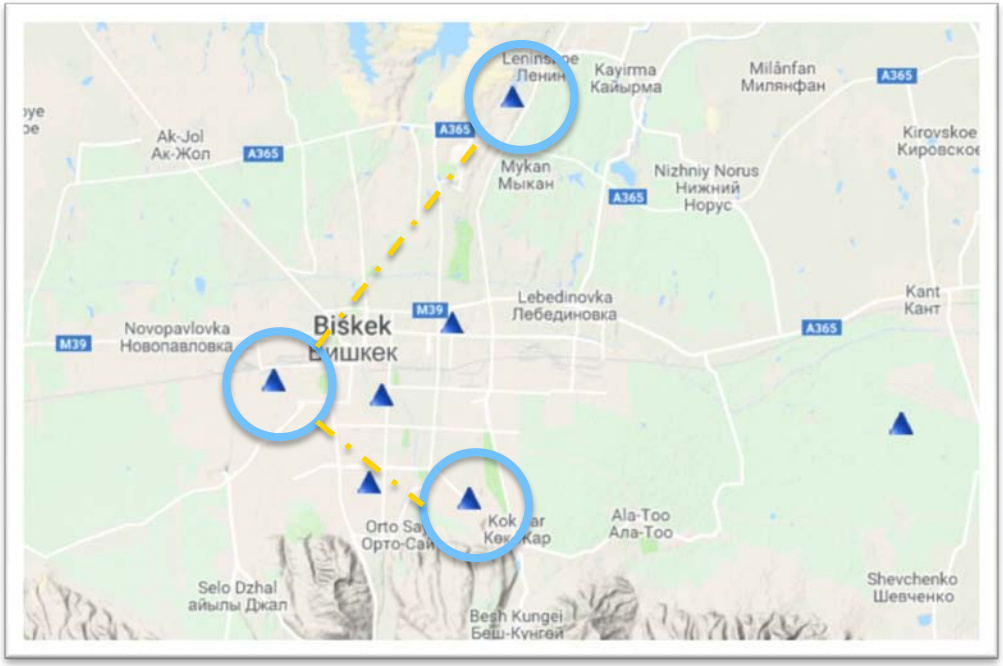
Real-time building monitoring and EEW

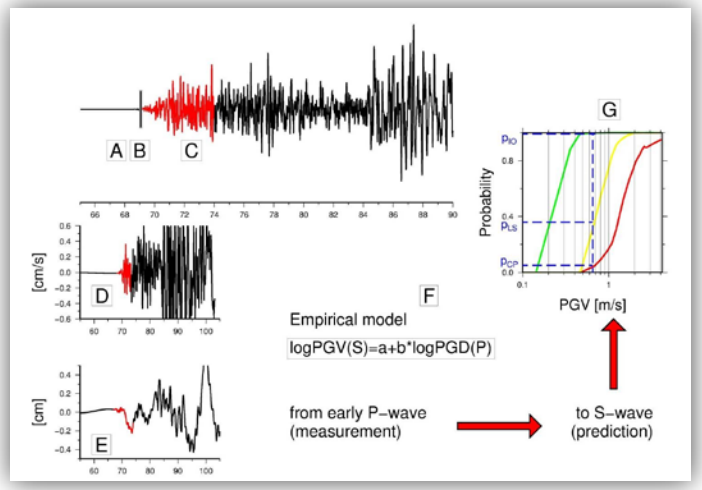


SOSEWIN & **MP-WISE**
Sensor platform

Performance-based **decentralized EEW**

De-centralized schema

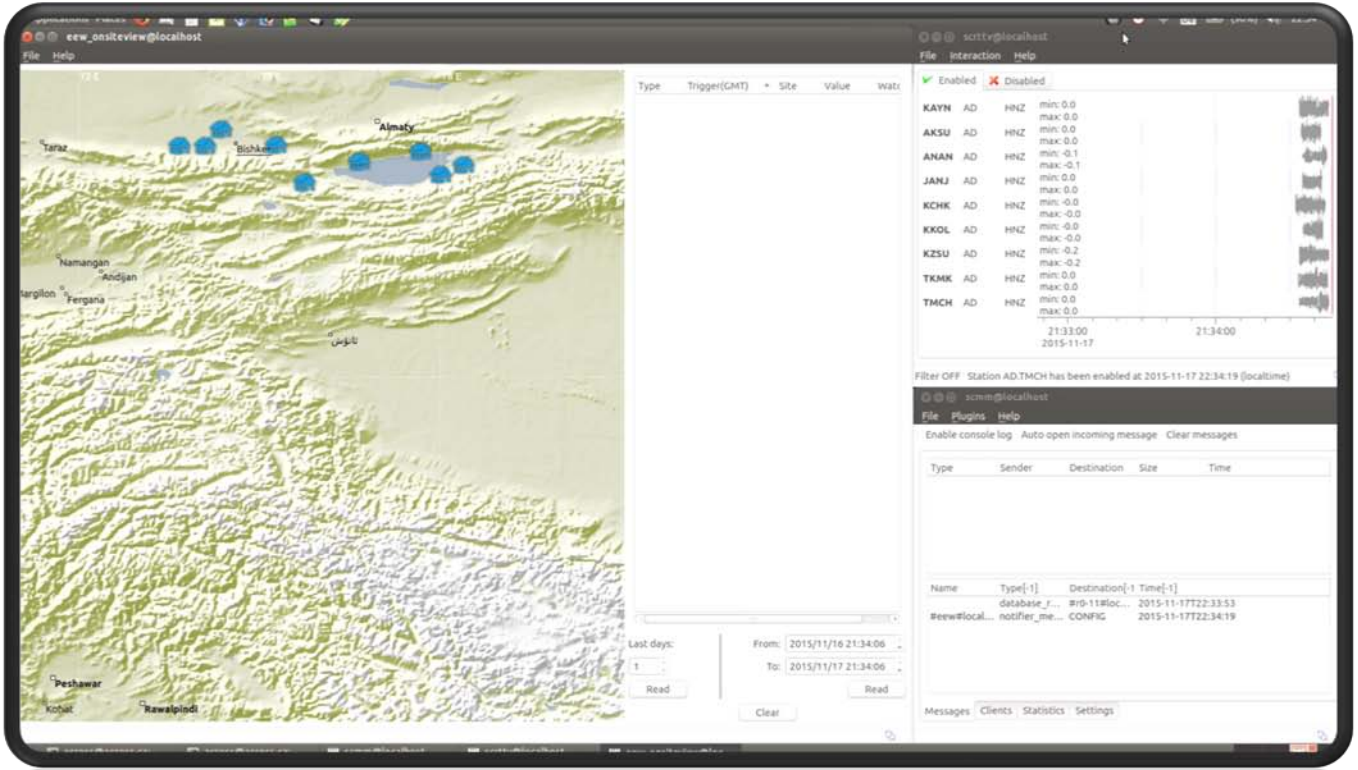




- Each sensor performs EEW autonomously
- Fragility models can be embedded

Parolai et al., 2017

GFZ-Sentry



M5.6 Osh, Kyrgyzstan 17/11/2015

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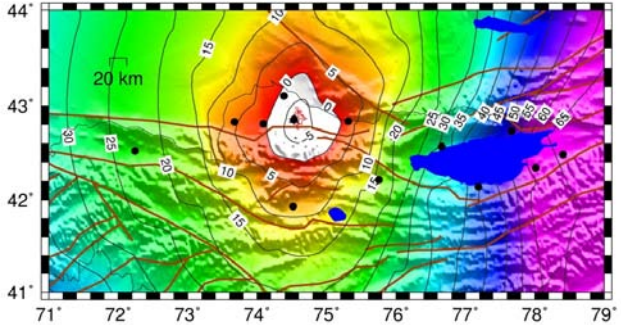
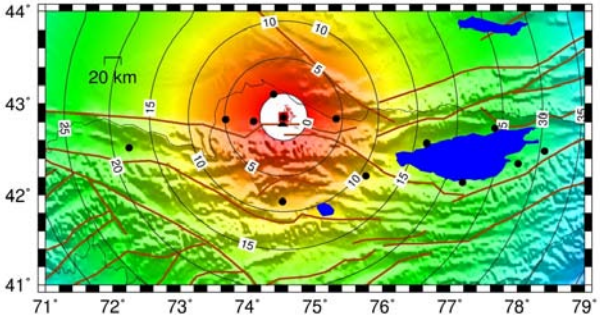
Hybrid Early Warning Systems

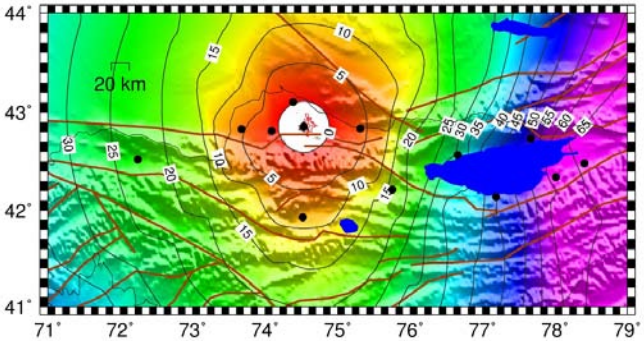
Regional



Decentralized

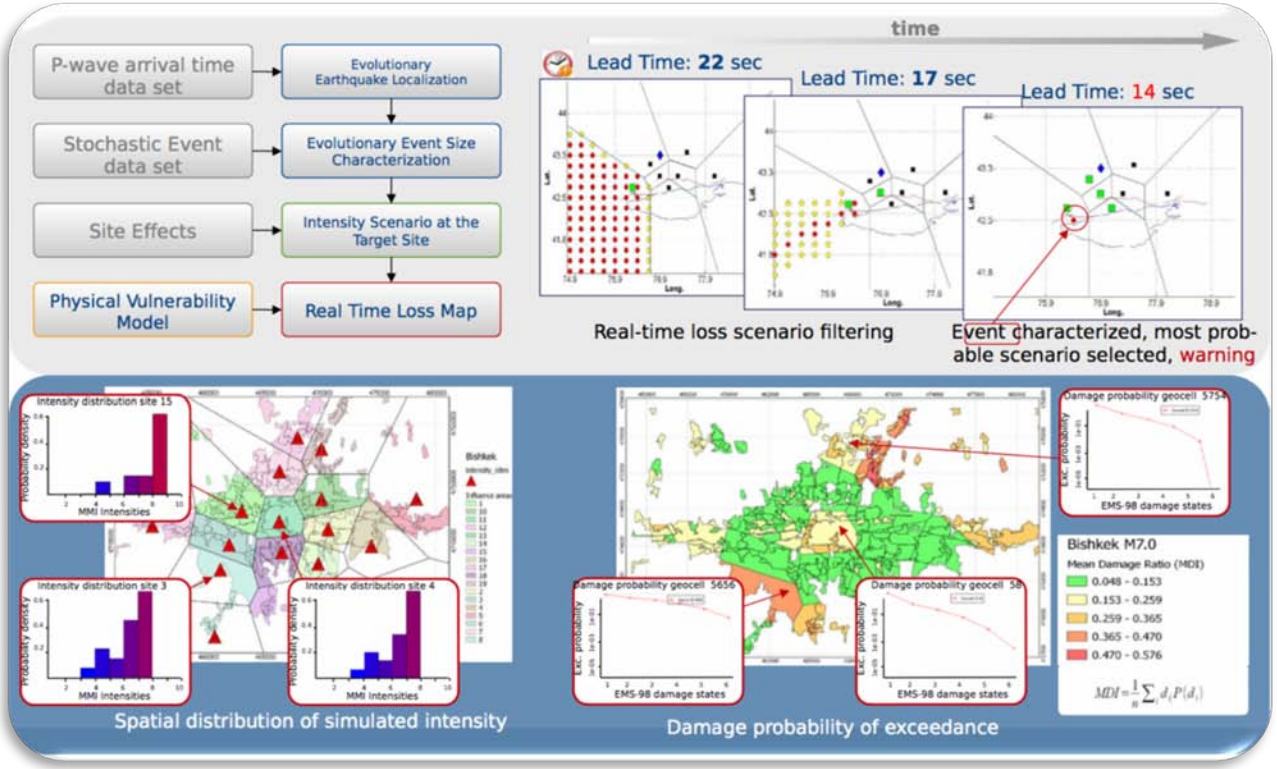


Hybrid (combined)



Parolai et al., 2017

From EEW to Rapid Response

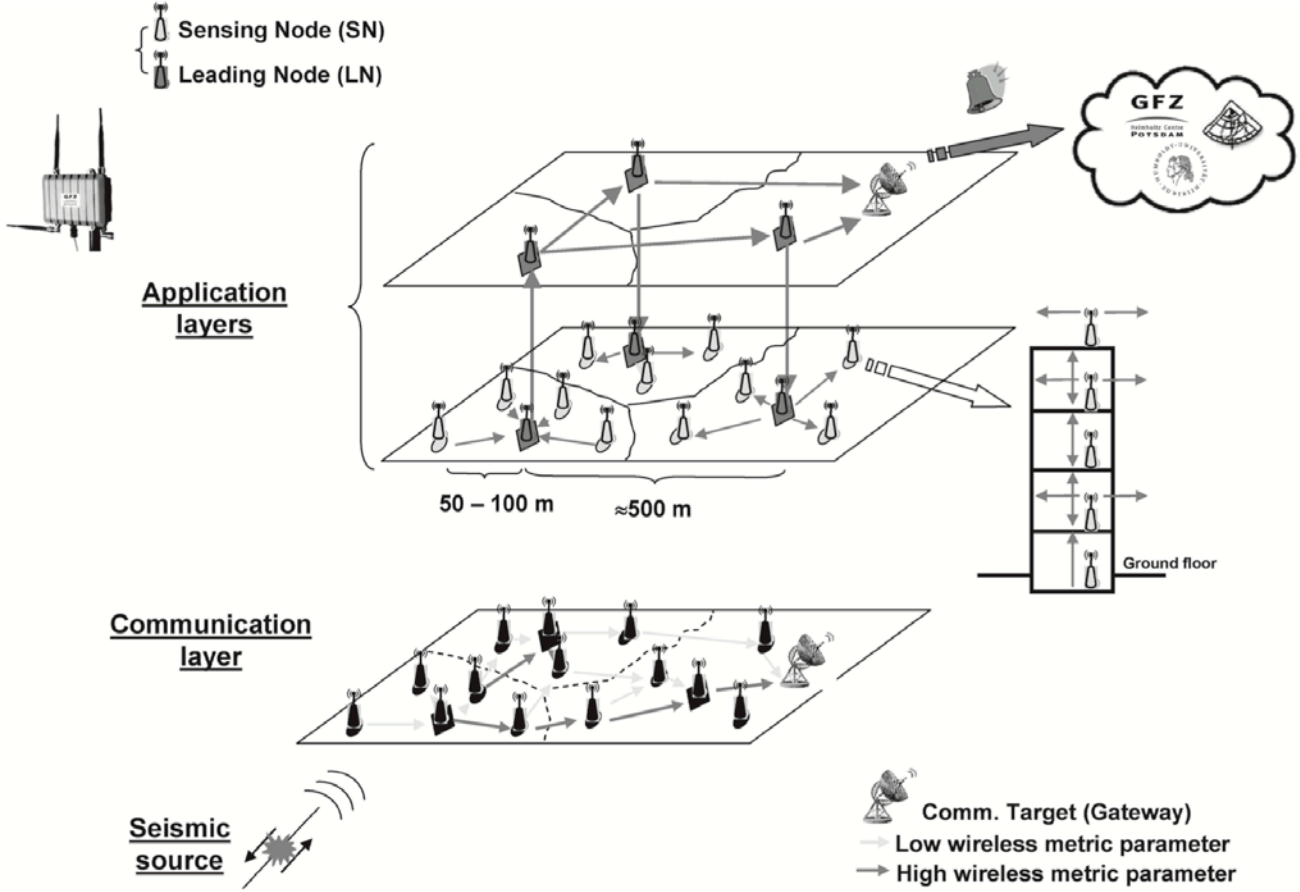


Incremental event characterization and Scenario picking

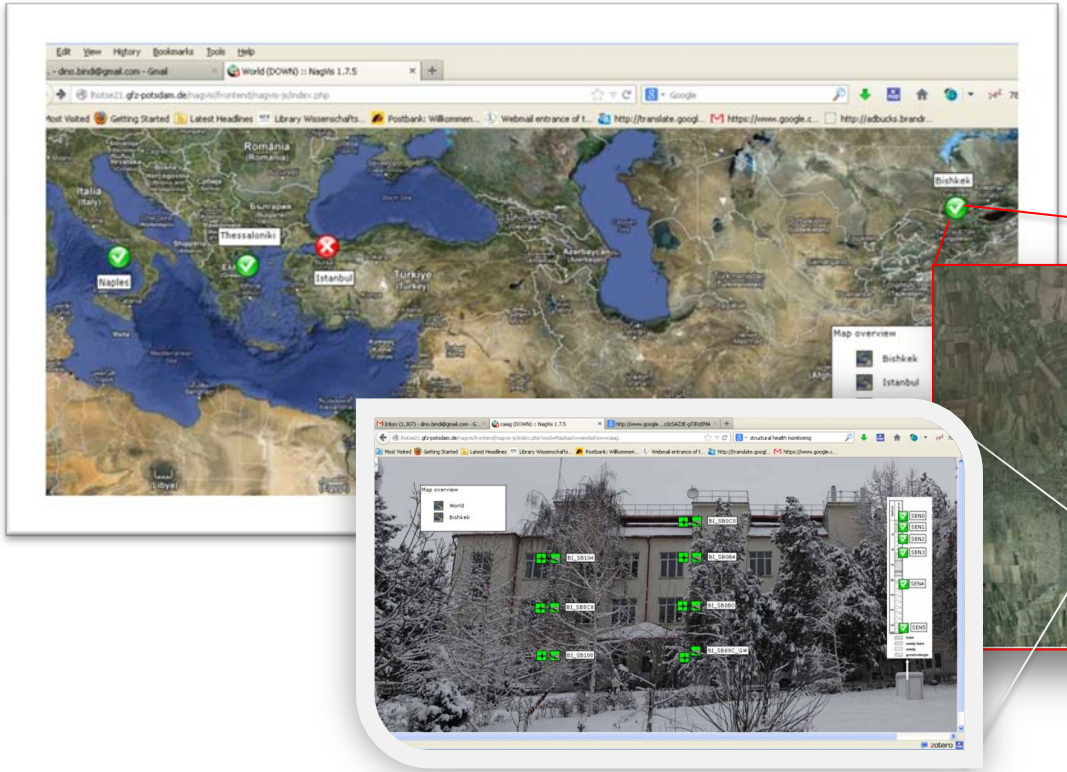
Real-time integration of urban sensors

Picozzi et al., 2013
Pittore et al., 2014

Application: local ad-hoc meshing

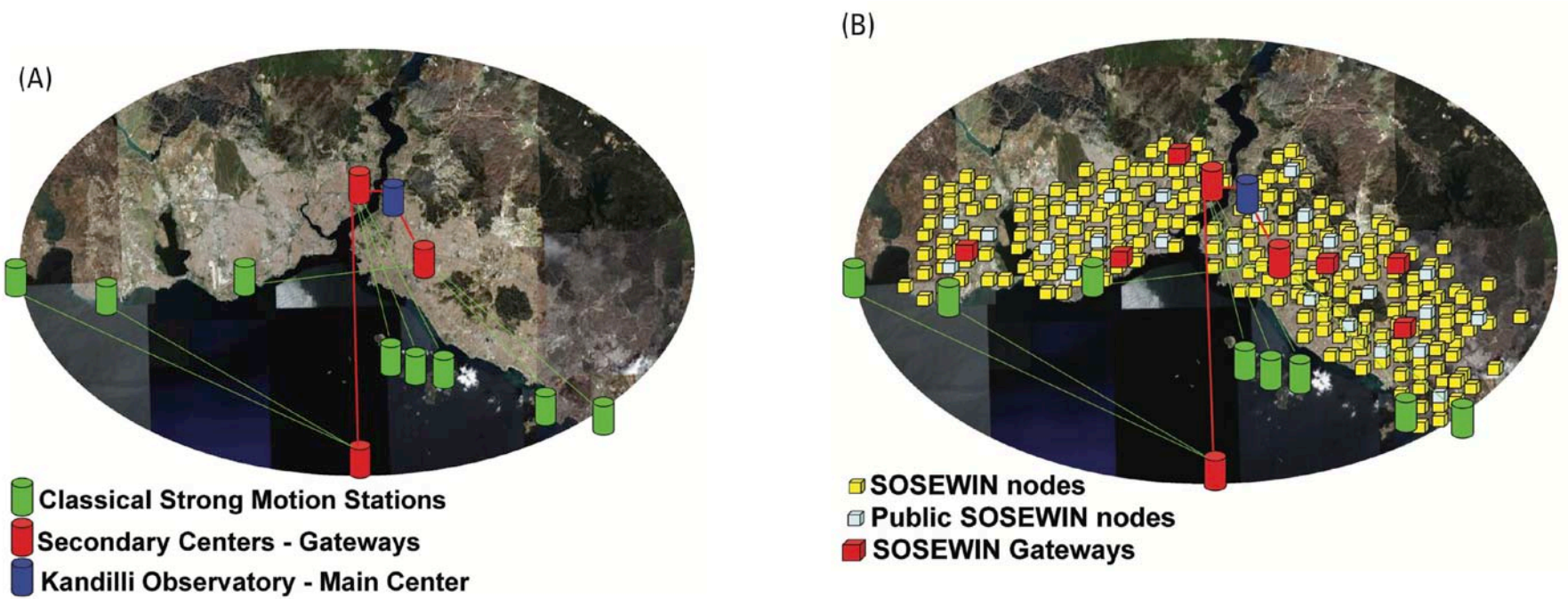


Real-time building monitoring

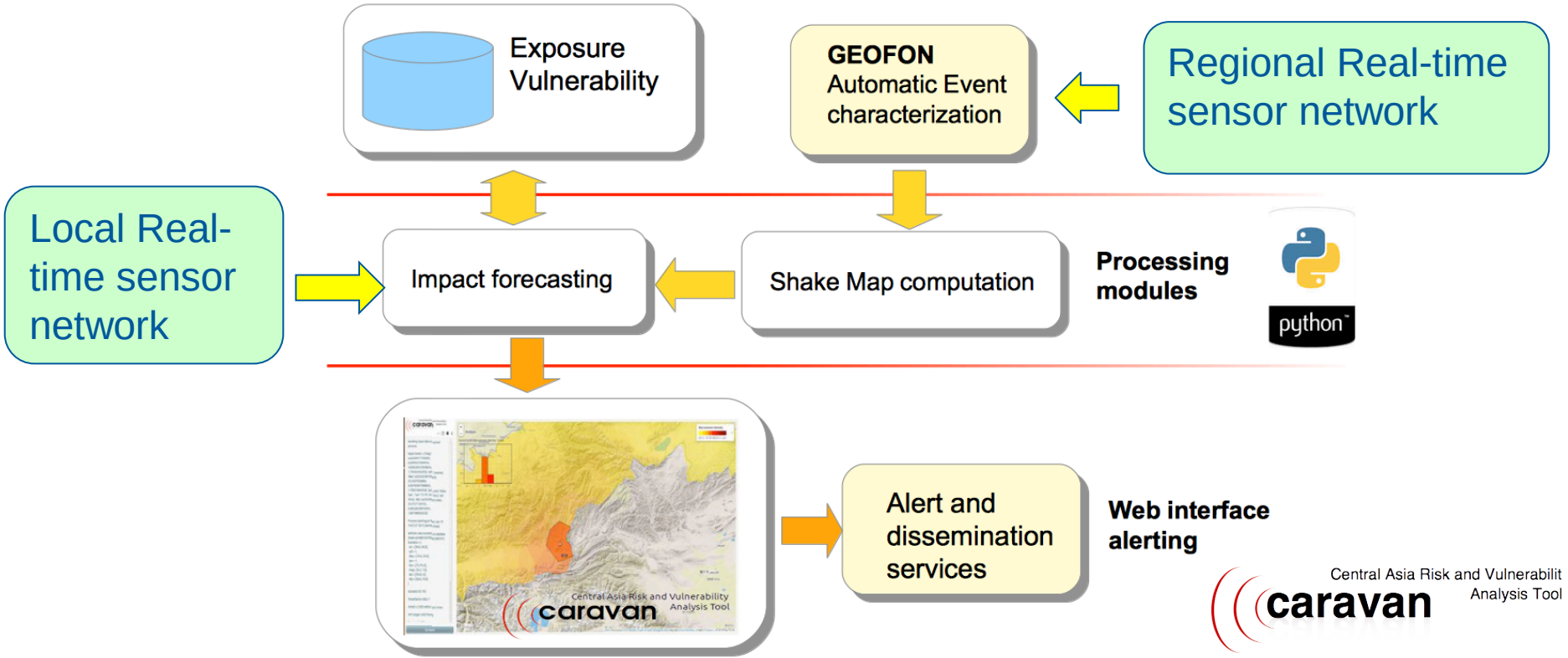


SOSEWIN & **MP-WISE**
Sensor platform

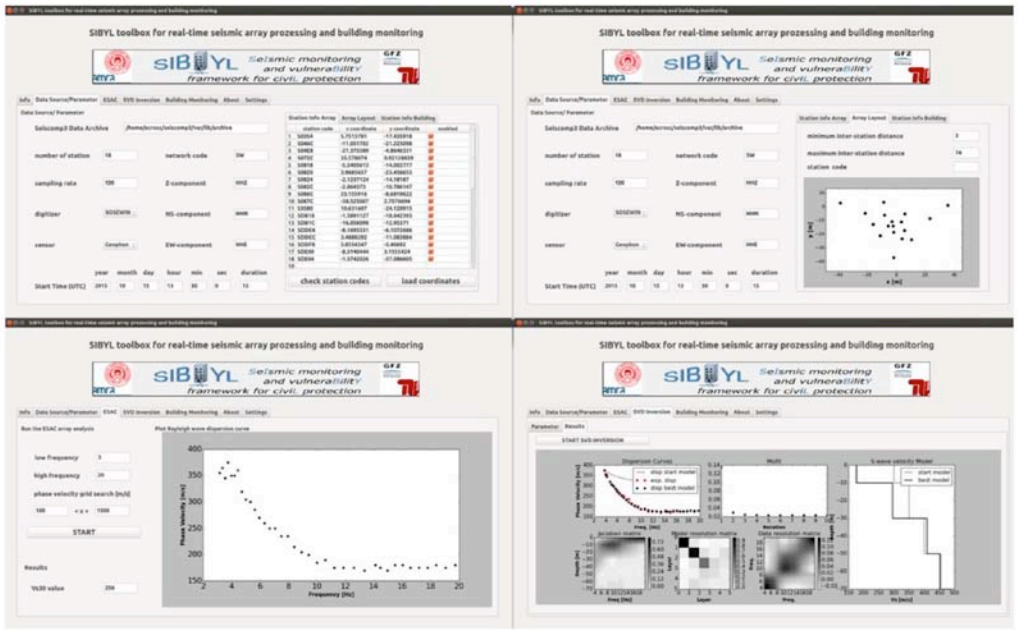
Test application: Istanbul

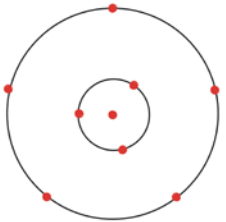


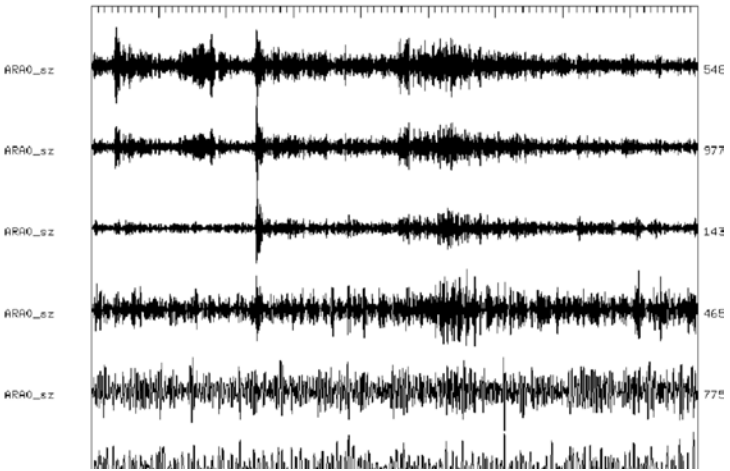
Central Asia Risk and Vulnerability Analysis Tool



Other applications: analysis of local site effects

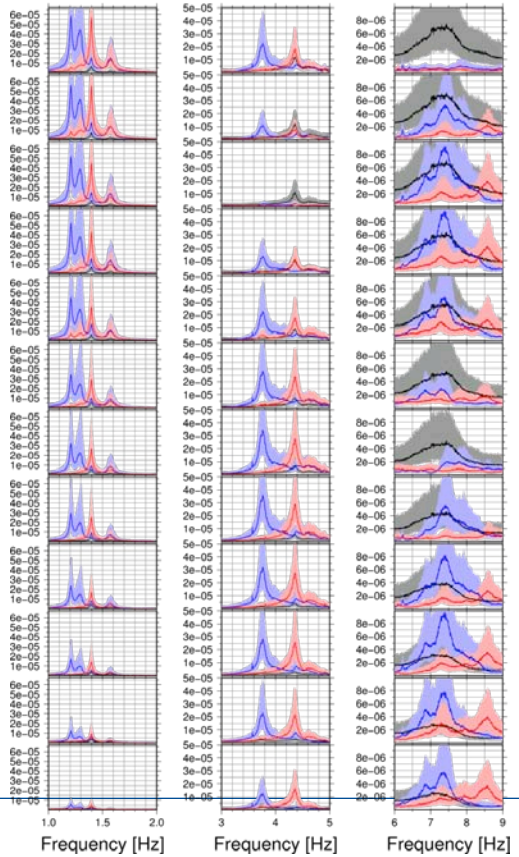






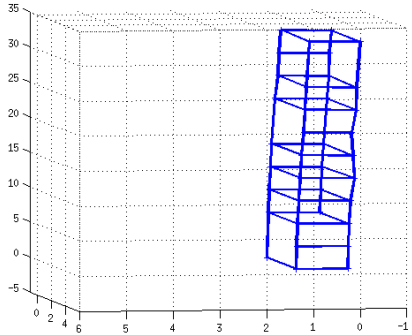
Other applications: building & soil-structure analysis

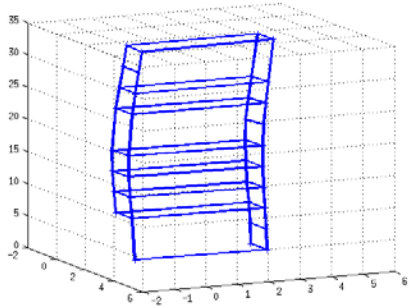
Moment Frame building, Istanbul



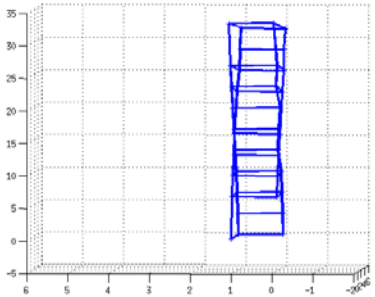
Other applications: building & soil-structure analysis

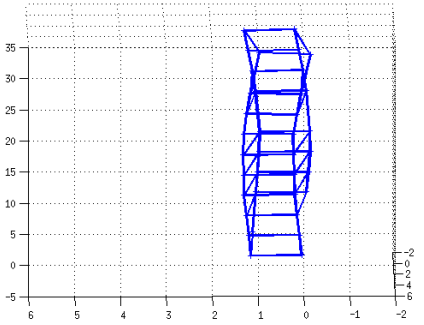
RC Panel building, Bishkek



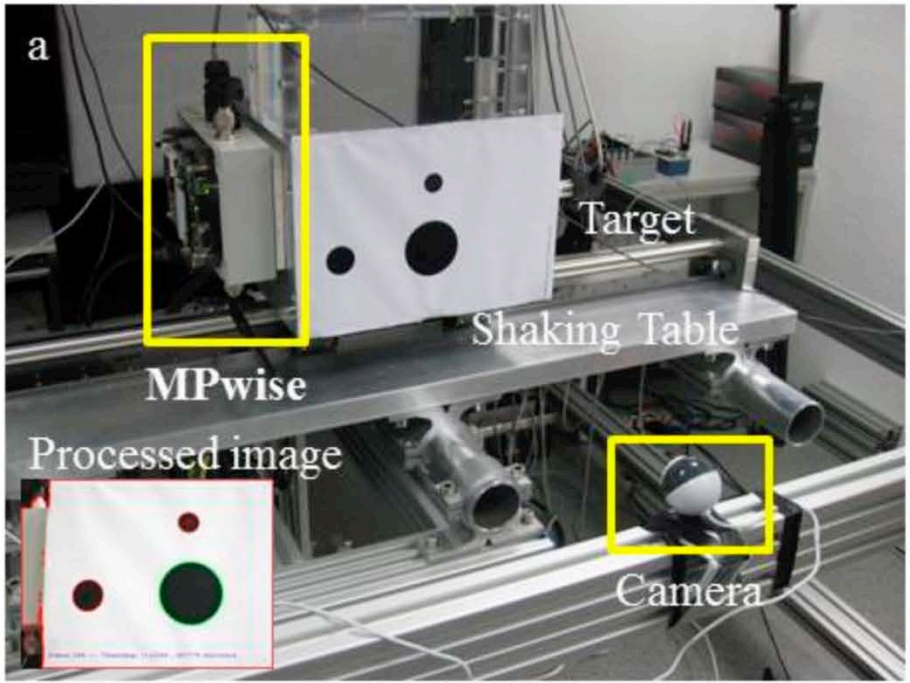


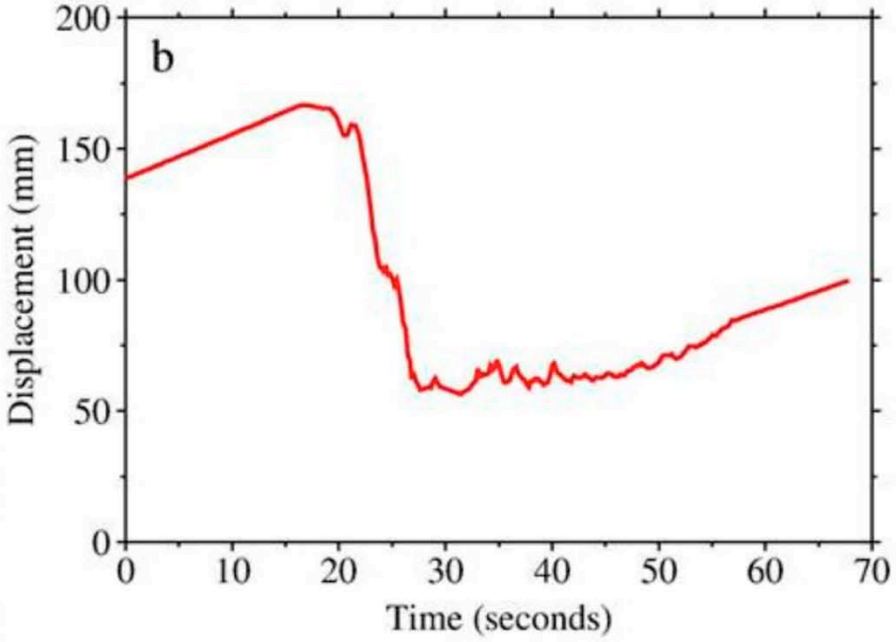
Principal vibration modes





Other applications: image-based damage detection





Outlook and conclusions

- New concept for EEW and Rapid Response:
  - Distributed
  - De-centralized
  - Optmized network
  - Performance-driven
  - Fault-tolerant, redundand
  - Standard brokering architecture (e.g. activeMQ)
  - Modular, multi-parameter sensors

Selected References

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DOI: 10.4401/ag-6687

Demos

ACROSS

Nagvis - ACROSS

Nagvis - SOSEWIN

DYNA Db

Early Warning

PRESTO sw

GFZ Sentry 1

GFZ Sentry 2

CARAVAN

On-line platform

Eq. 23/12/2015

FDSN demo