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FNSNF

Fast Detection of Hazardous Mass Movements with GNSS Low-cost Sensors

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Motivation

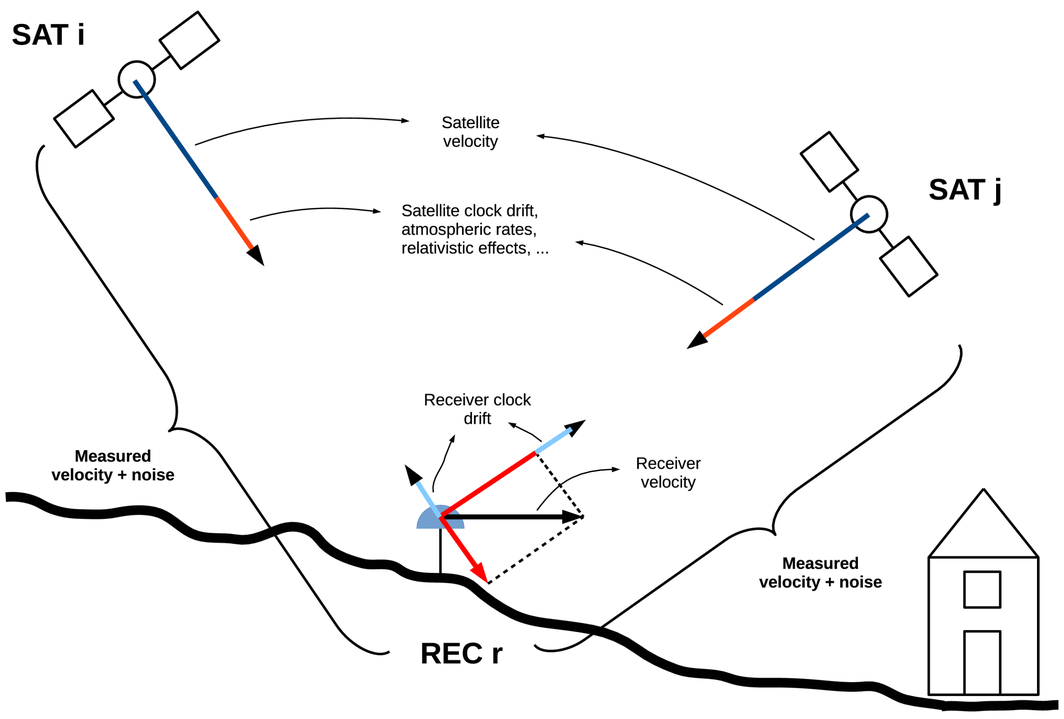
Fast detection of hazardous mass movements in high alpine regions with low-cost single-frequency GNSS (Global Navigation Satellite System) receivers. Integration in an early-warning system

GNSS equipment is embedded within a wireless sensor network which shall be waken up by acoustic emission of a hazardous event

[Limpach, EGU, 2012]

Principle

Movement detection based on estimation of receiver velocity from reduced receiver-to-satellite line-of-sight Doppler velocity observations (to at least 4 GNSS satellites)



Algorithm

WORKFLOW:

(1) Model contributions to velocity observations
Analytical and empirical models for satellite velocity, relativistic and atmospheric effects → 'Predicted'

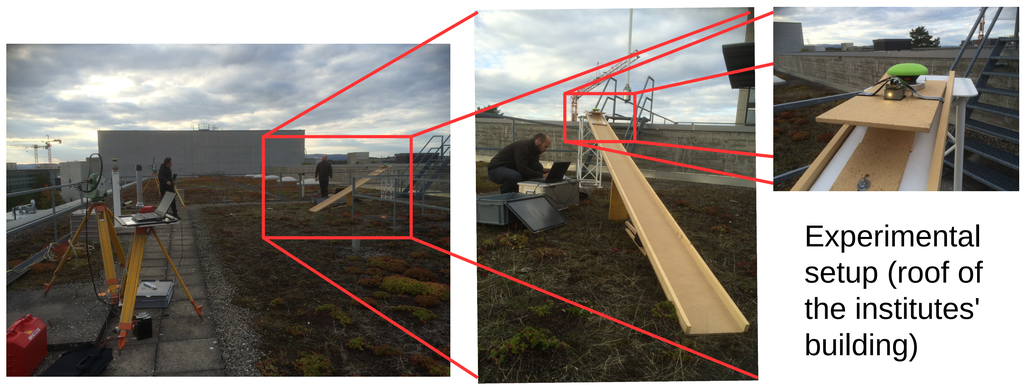
(2) Reduce velocity observations
→ 'Observed – Predicted'

(3) Estimate unknowns (Kalman Filter)
→ Receiver velocity components (x, y, z in WGS84)
(Furthermore: acceleration, clock drift …)

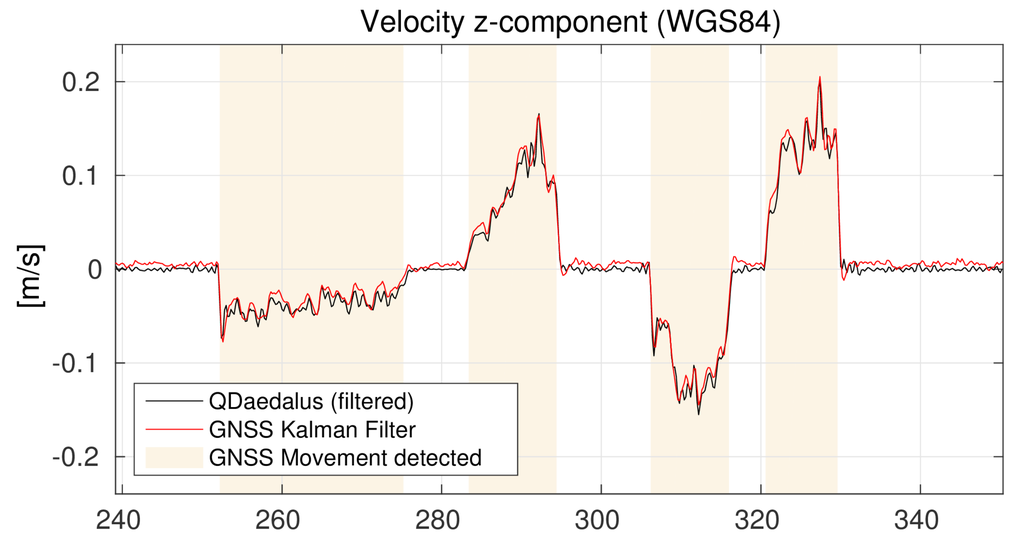
(4) Statistical testing of velocity estimates
→ Detect Movement

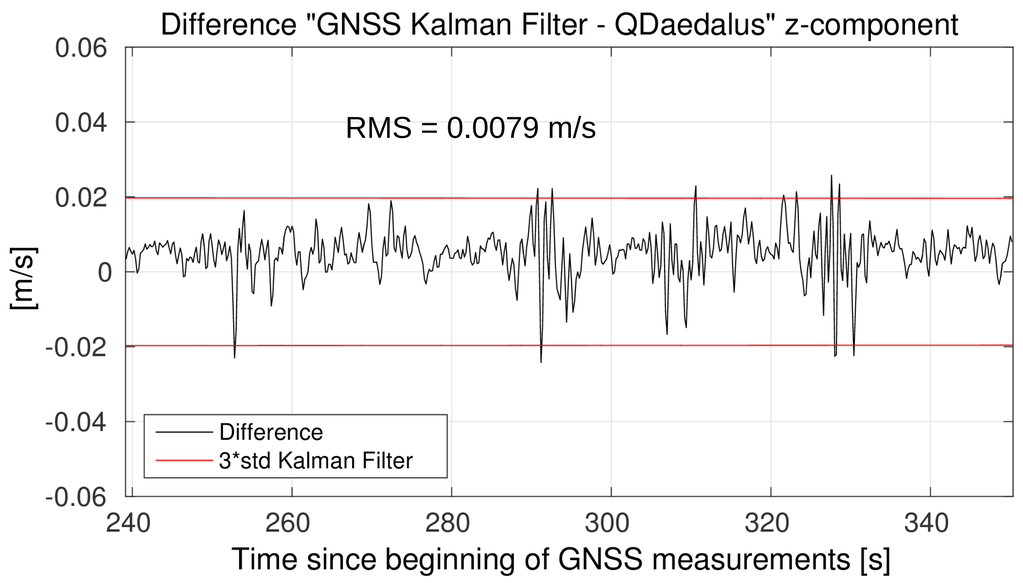
Experimental Results

Experiment with a guided slide Equipment: U-BLOX EVK-M8T Evaluation Kit with JAVAD Gr-Ant-G3T antenna (5 Hz Sampling, GPS and GLONASS). Ground truth with *QDaedalus* (high accurate videotachymetric system)



Experimental setup (roof of the institutes' building)





Top figure: GNSS velocity estimates, velocities from QDaedalus and detected GNSS movements **Bottom figure:** Difference between GNSS and QDaedalus velocity series. Most of the residuals lie within the accuracy band obtained for the GNSS velocities, which implies their reliability

Summary

- Movements as slow as ~1 cm/s can be detected
- Movement information could be provided within seconds (no GNSS phase ambiguity resolution necessary)
- Autonomous: No data from GNSS reference station are needed