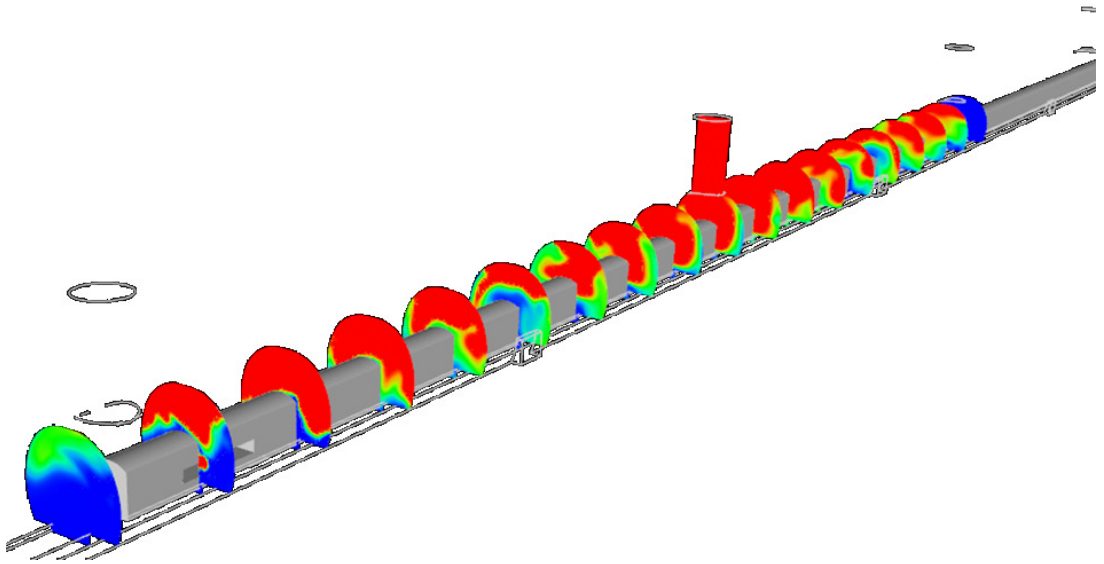
AFC Brandschutz

Fire and Smoke Removal Simulations in Swiss Railway Tunnels

SaveMe Conference, Rome, March 3rd, 2011

Dr. Alois, Schaelin, Dr. Christian Del Taglia

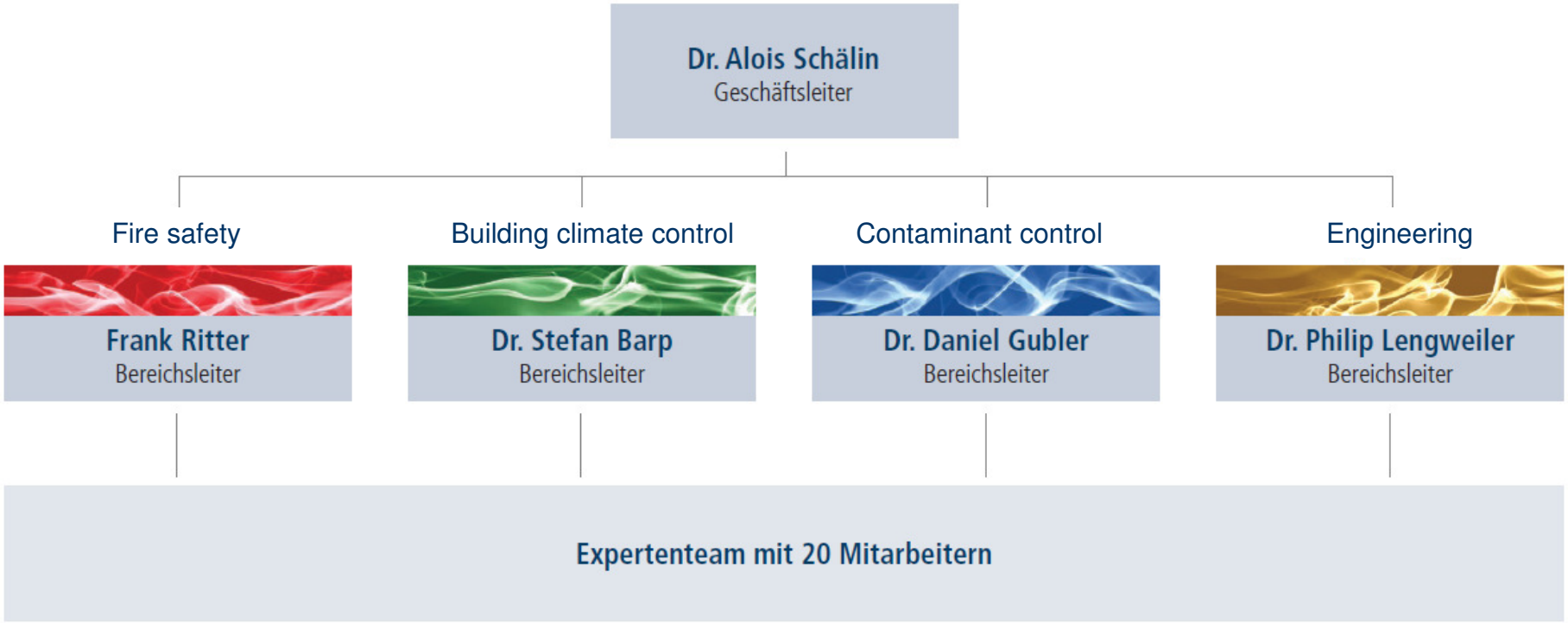


Version: 22.02.2011

Overview

- Activities
- 4 Examples
- Conclusions

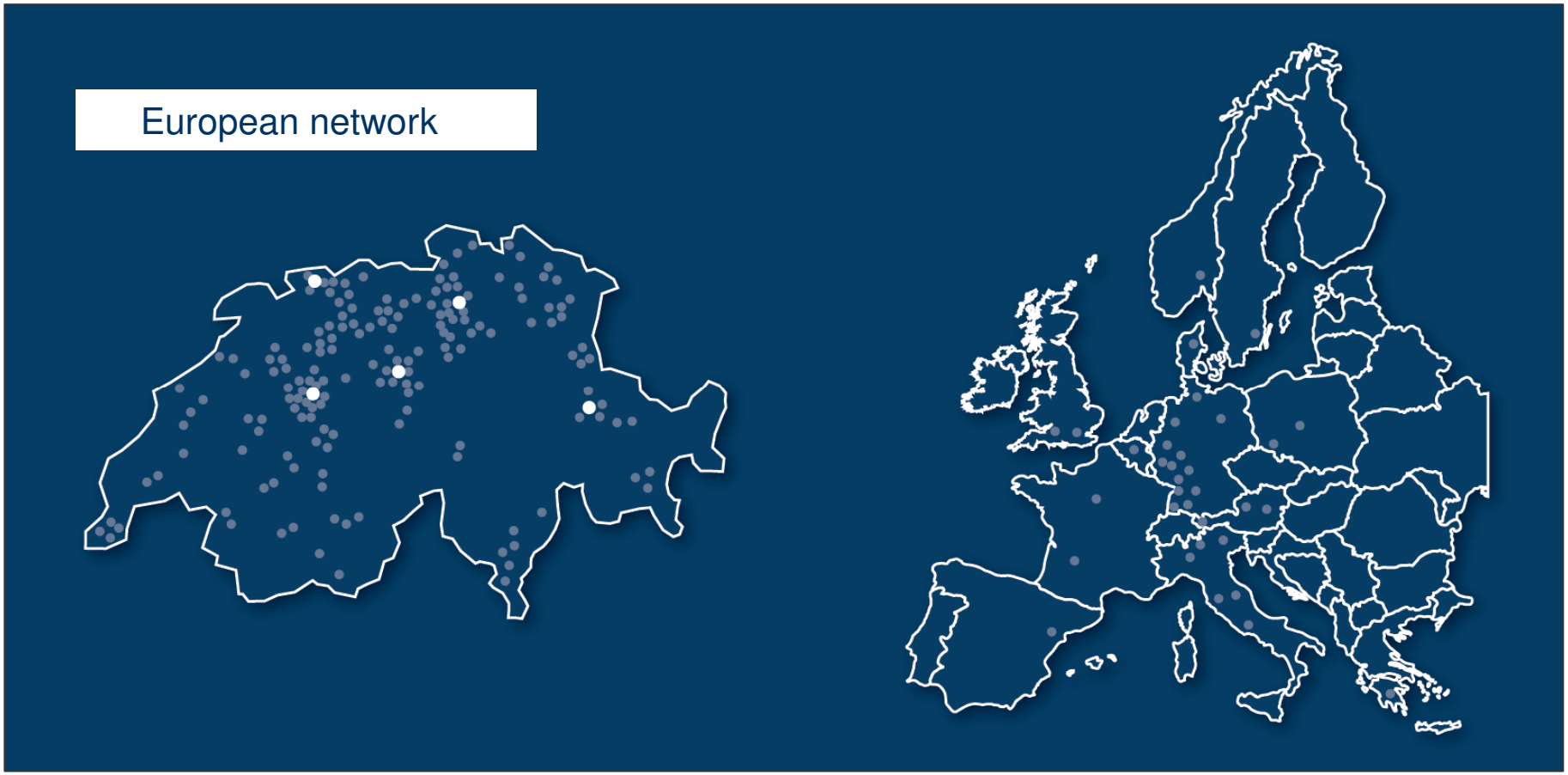
Portrait



Key points

- Founded in 1995 as spin-off company of the Swiss Federal Institute of Technology
- Since 2000: Corporation
- Since 2010: Team of experts (20 employees)
- Member of Technet Alliance
- Cooperation on national and international R&D-projects
- High end technical infrastructure

Sites



Headquarter
AFC Air Flow Consulting AG
Weinbergstrasse 72
8006 Zürich

Sites
Zürich
Bern
Basel
Luzern
Chur

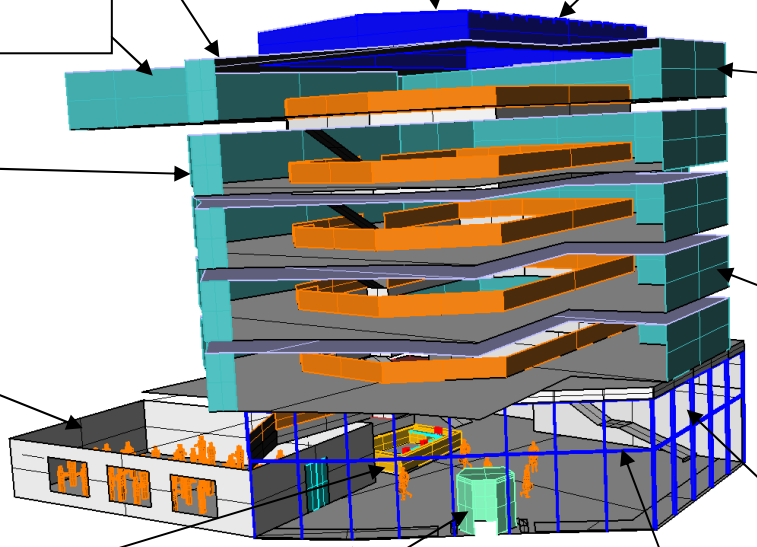
Fire safety and Building climate control

Luftansaugung aussen:
- Ansaugung von Sanitärabluft
- Ansaugung von Abgasen z.B. von Notstrom

Natürliche Lüftung Halle über Dach:
- Erforderliche Klappenfläche
- Thermisch aktivierbare Gebäudemasse

Dach mit hohem Glasanteil:
- Zugluft im Winter auf allen Geschossen
- Überhitzung im Sommer

Restaurant / Cafeteria:
- Geruchsverteilung im Gebäude



Fassade mit hohem Glasanteil:
- Überhitzung (hoher Kühlbedarf) im Sommer.
- Kaltluftabfall im Winter
- Dimensionierung TABS, Kühldecke, Lüftung

Büro:
- Zugluft durch Lüftung
- Lokale Luftqualität

Auditorium:
- Zugluft durch Lüftung
- Lokale Luftqualität

Doppelfassade:
- Überhitzung (hoher Kühlbedarf) im Sommer
- Kombination Sonnenschutz, Verglasung, Spaltbreiten

Empfangstheke:
- Gestaltung für optimalen thermische Komfort

Eingang:
- Zugluft bei Empfang
- Energieverlust im Winter wegen Abströmung durch offene Fenster oben
- Dim. Luftschleieranlage

Hohe Fassade:
- Kaltluftabfall im Winter
- Überhitzung im Sommer

Klappen zur natürlichen Lüftung:
- Erforderliche Fläche
- Regelung
- Optimierung im Betrieb

Reference projects



SIA Hochhaus, Zürich



Anglo Irish Bank, Dublin



Stadtspital Triemli, Zürich



Bundeshaus, Bern



Kolping Arena, Kloten



Flughafen, Zürich



ETH Science Laboratory, Zürich



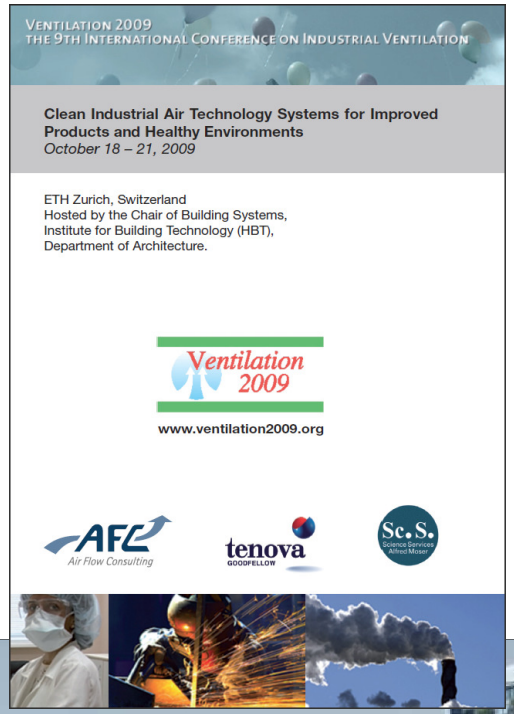
BMW Sauber, Hinwil

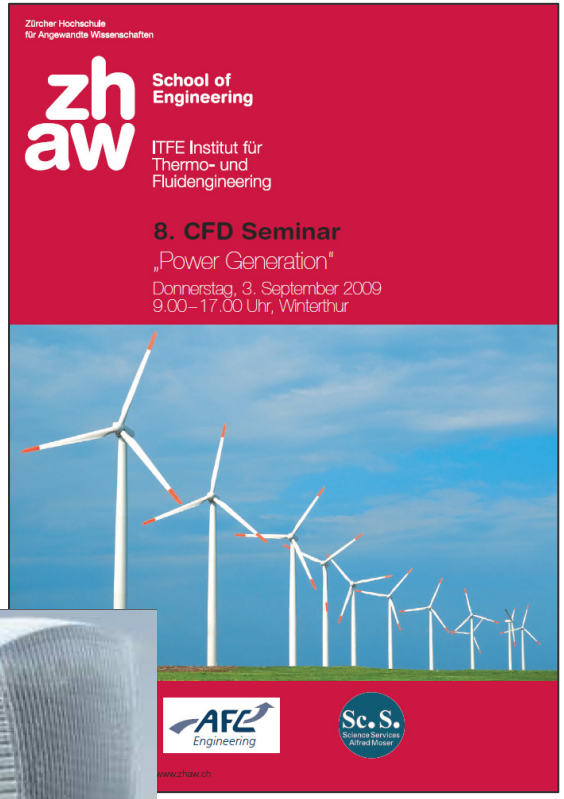


Landesmuseum, Zürich

Organisation of conferences









Requirements in fire safety

- Fire safety concept objectives
  - Prevention
  - Damage limitation
  - Smoke free evacuation paths
  - Safe fire brigade intervention

- Different measures: structural, technical and organizational

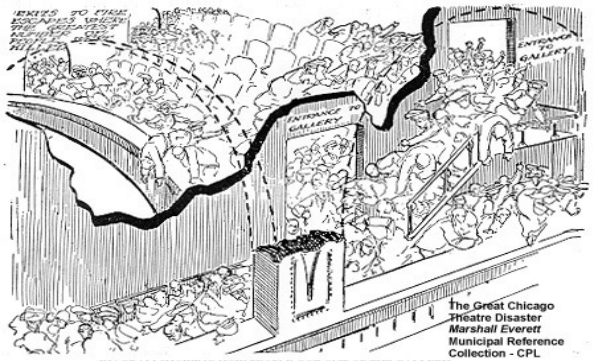


DIAGRAM SHOWING HOW PEOPLE GOT OUT OF THE GALLERY

1904 Iroquois Theater
Chicago: > 600 dead people



1977 Beverly Hill Super Club
165 dead people



1998 Disco Göteborg
63 dead people

Detailed planning and customized concepts

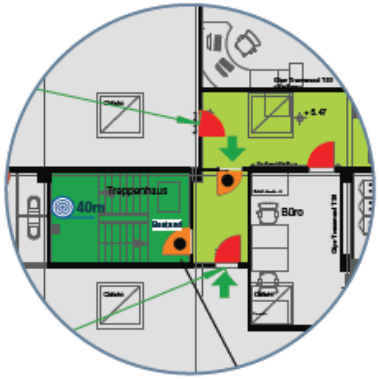




Ausssagekräftige Brandschutzpläne

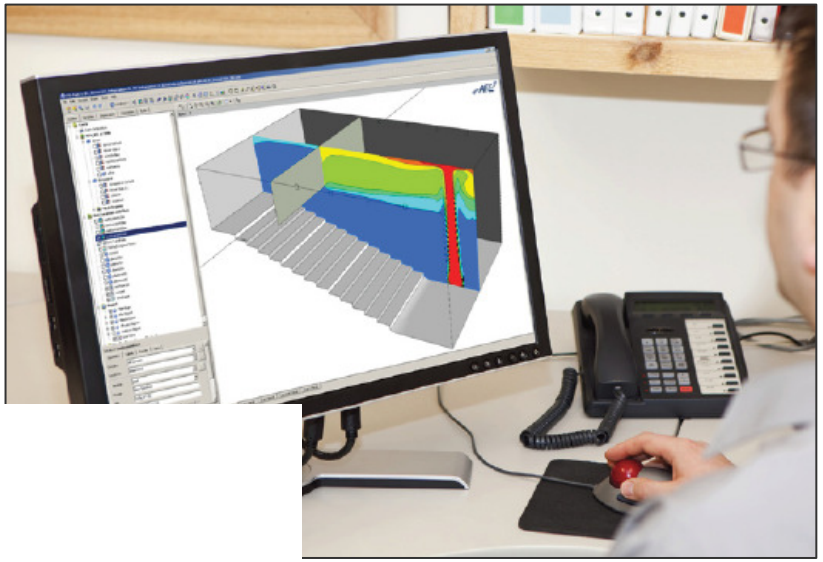
Normgerechte Legenden/Symbole

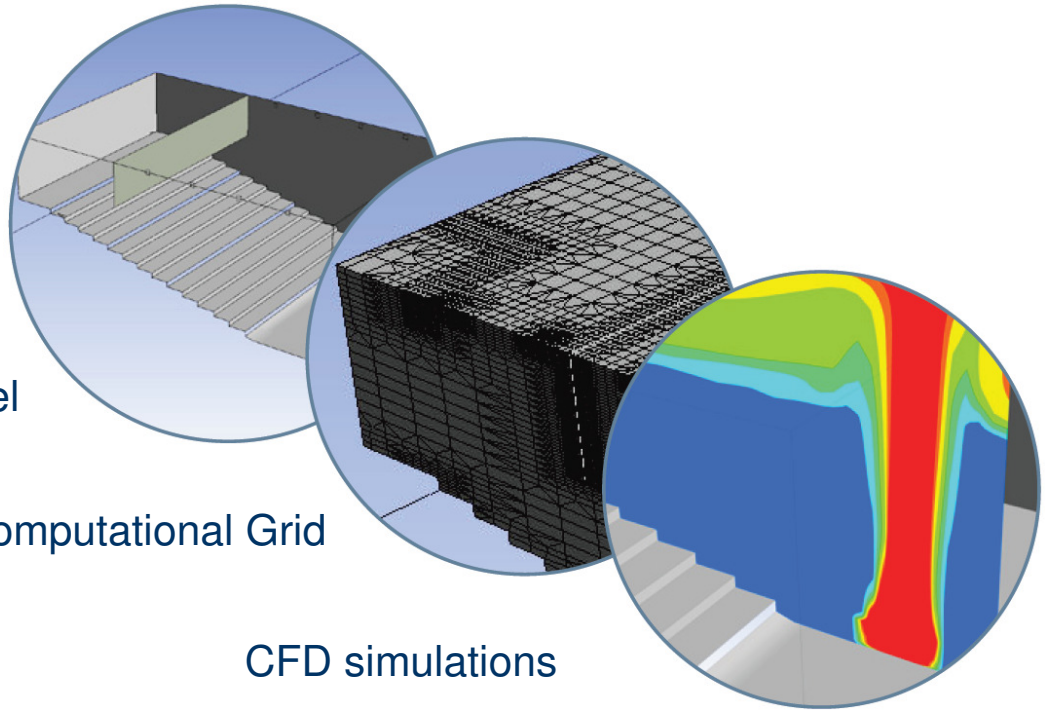




Klare und übersichtliche Darstellung

Performance based approach with numerical simulations (Computational Fluid Dynamics, CFD)





On site tests with hot smoke generator





Versuchsanlage für Warmrauchversuche nach VDI 6019-1

Funktionstest aller Komponenten z.B. RWA Klappen



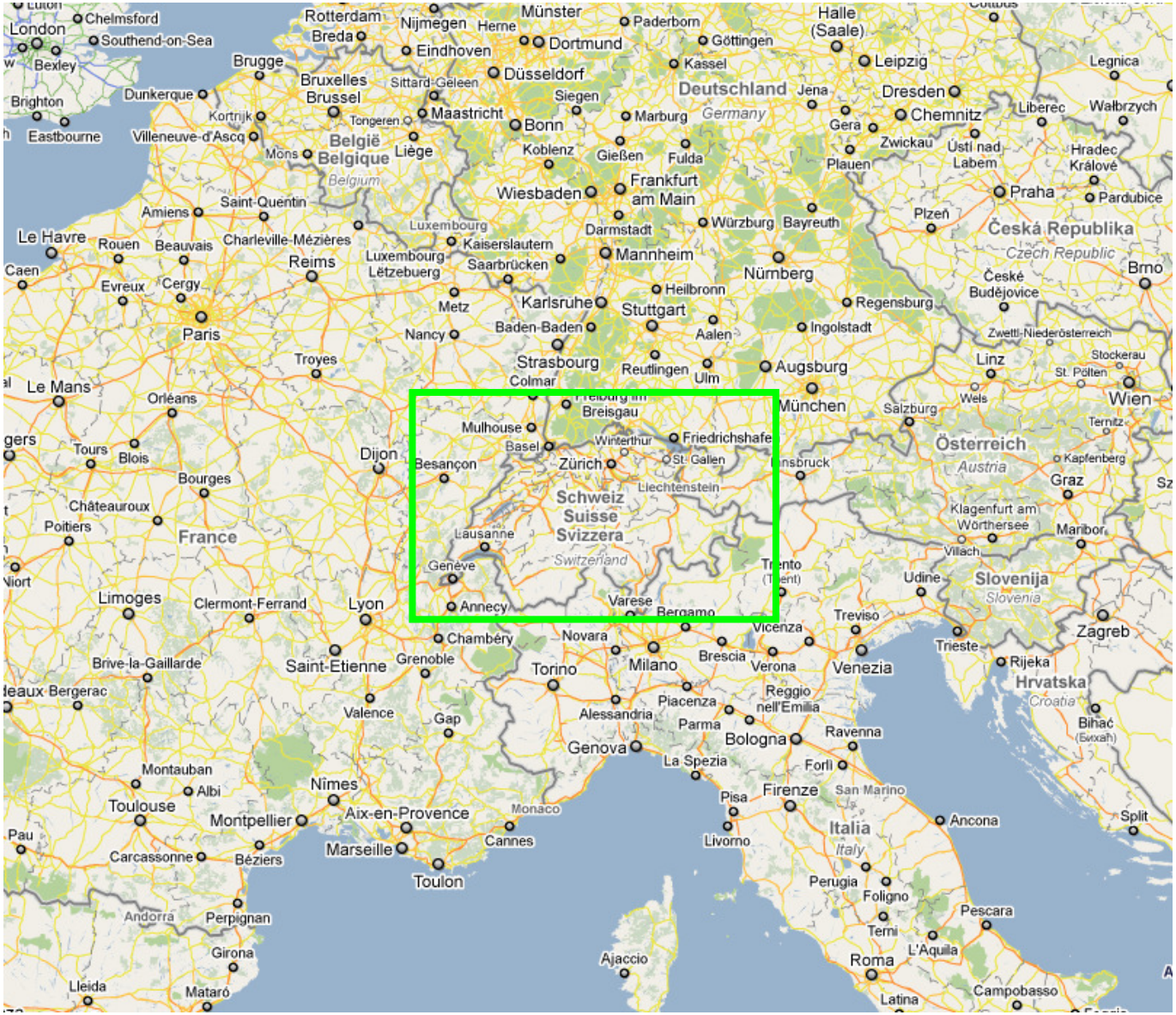


Fachmännische Organisation der Integralen Tests

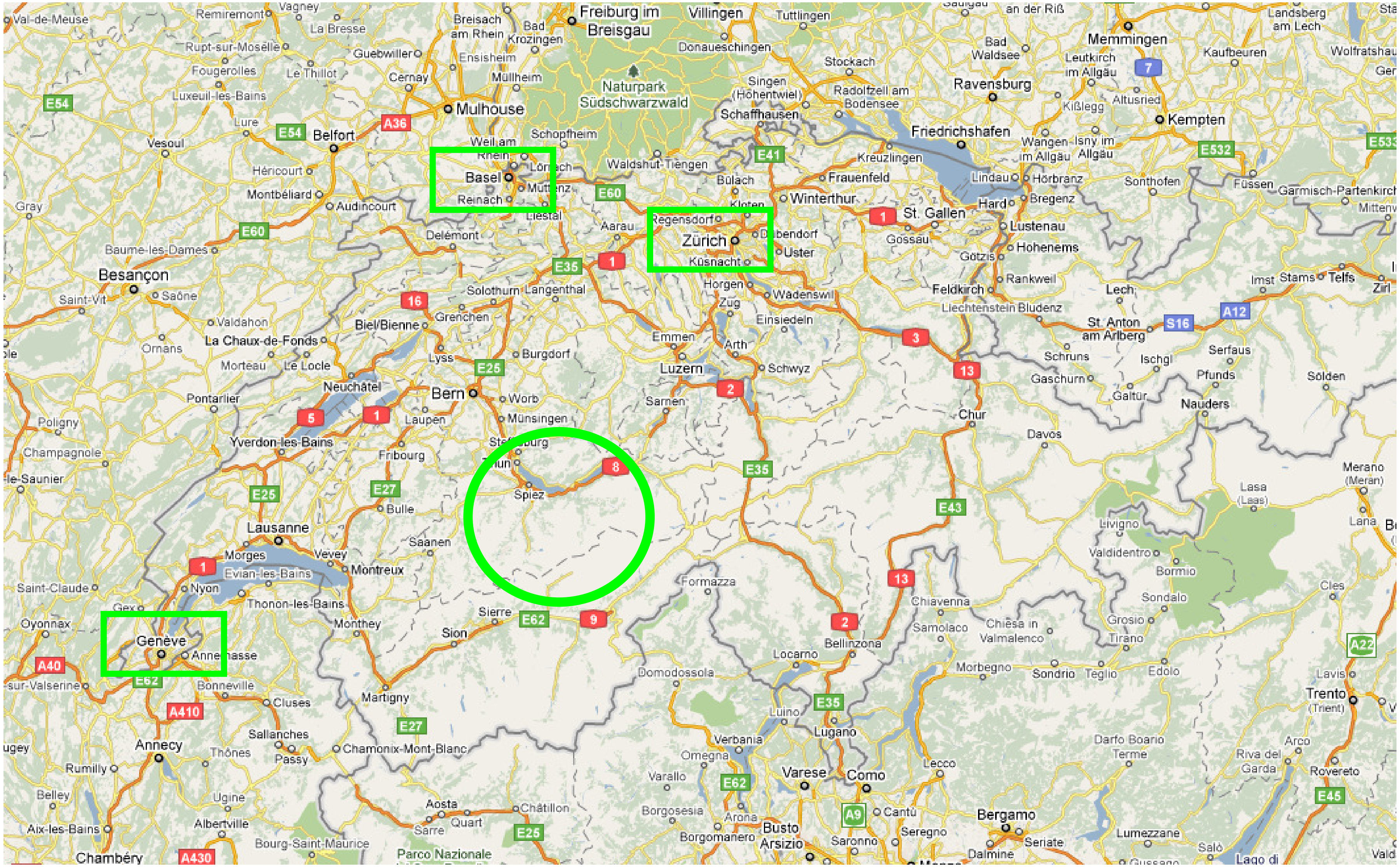
Examples

- New Underground Station Löwenstrasse
- Tunnel Lötschberg, Neat-Project
- Tunnel Belchen
- Tunnel Sonnenberg

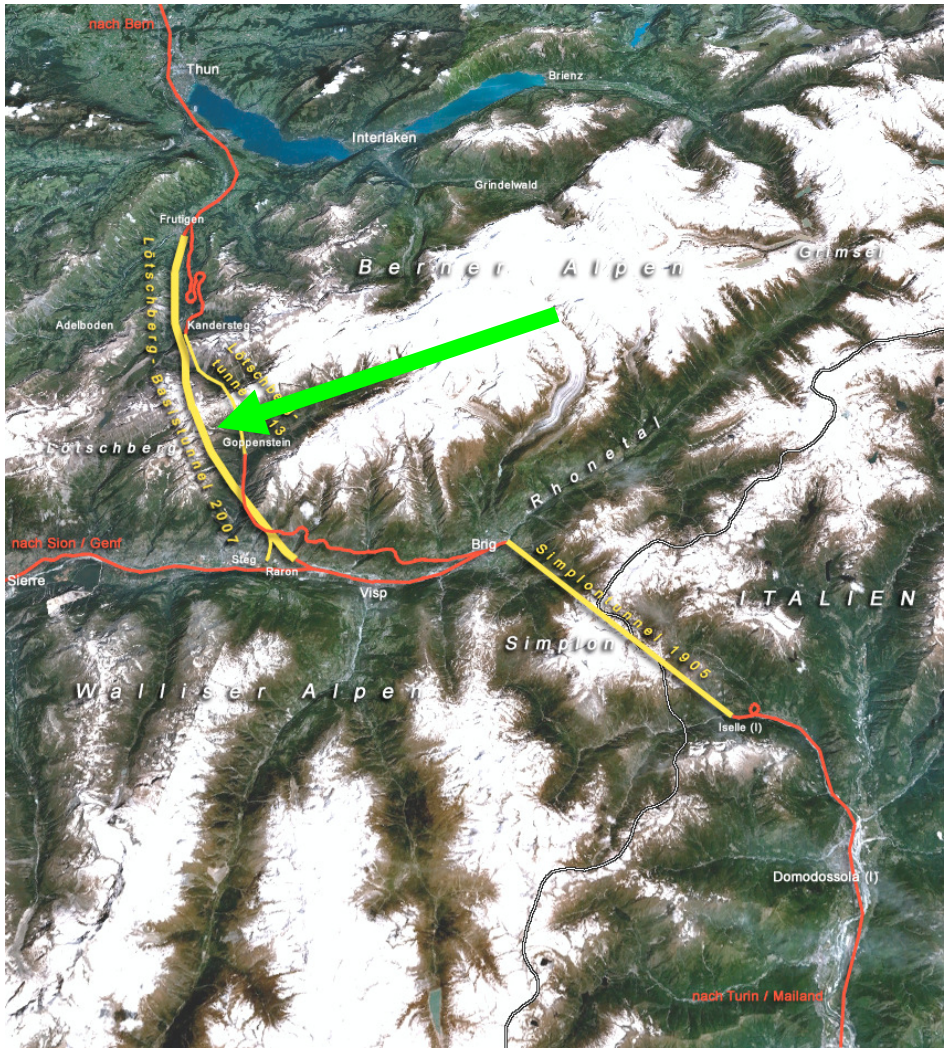
Tunnel Lötschberg

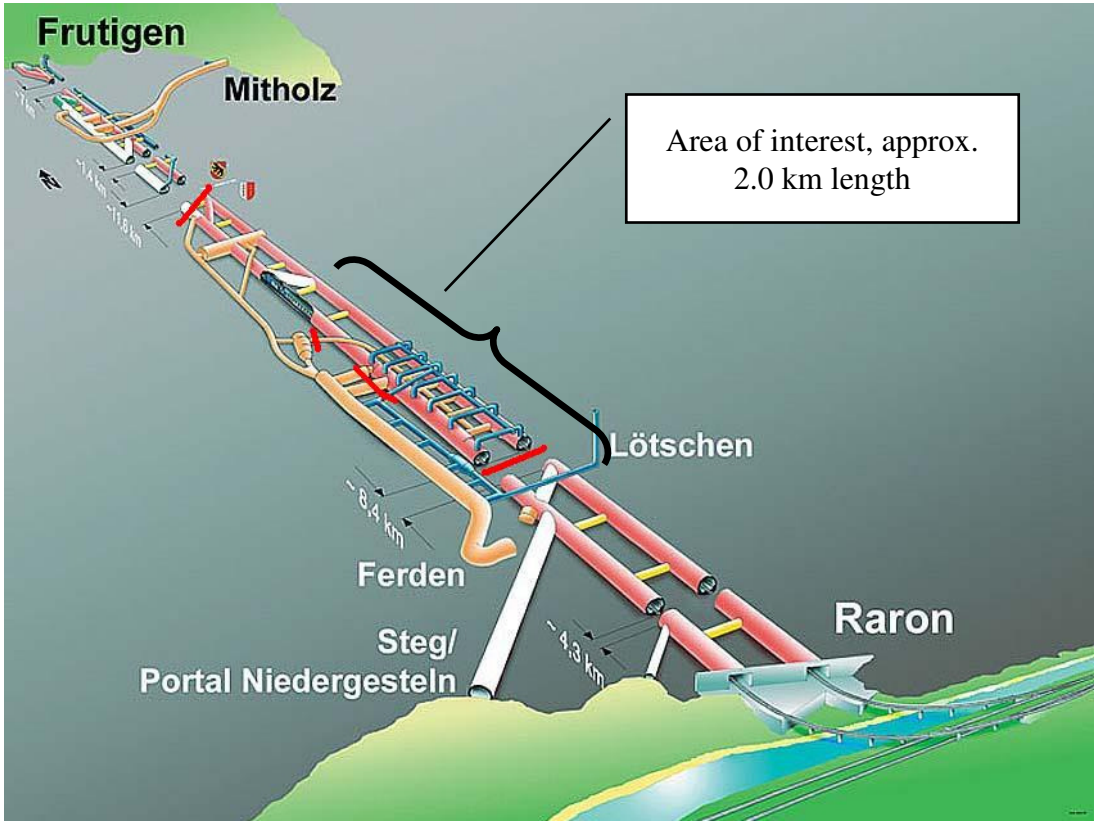


Tunnel Lötschberg



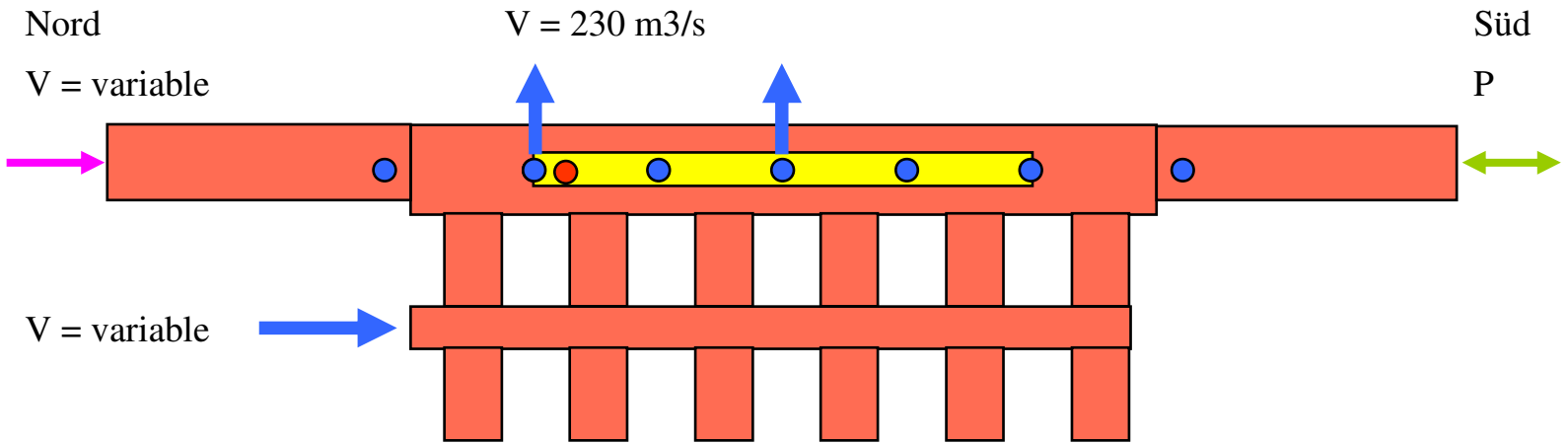
Tunnel Lötschberg





Overview of tunnel and safety station

Tunnel Lötschberg



→3 Movies

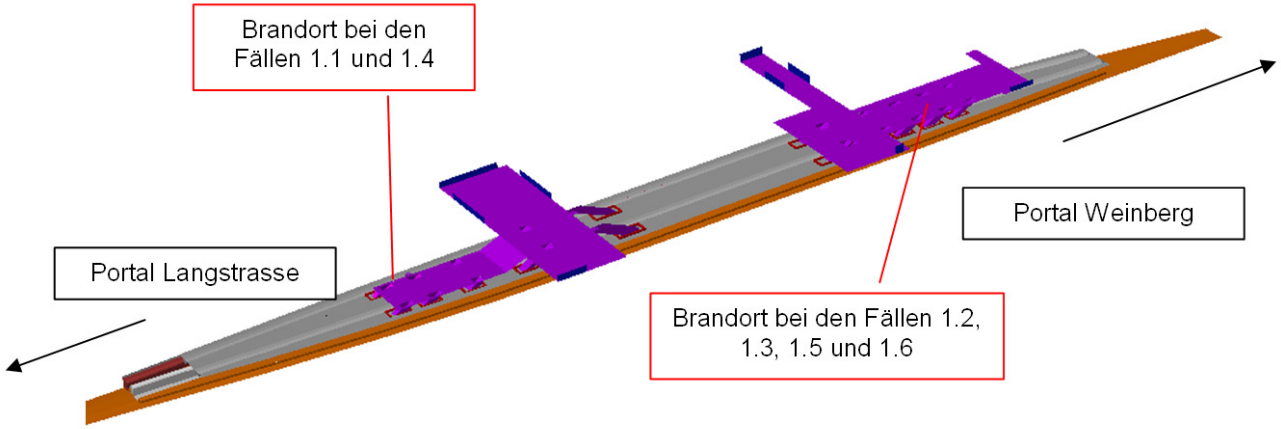
New Underground Station Löwenstrasse



New Underground Station Löwenstrasse

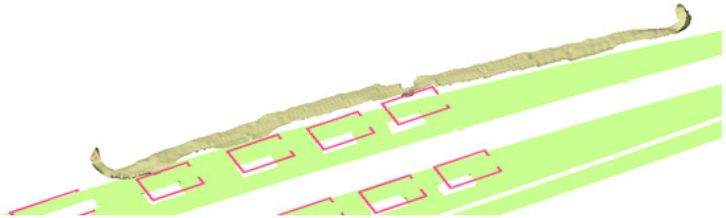




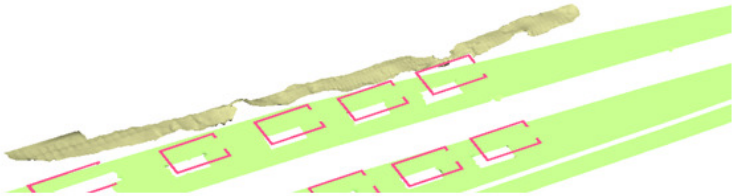


New Underground Station Löwenstrasse

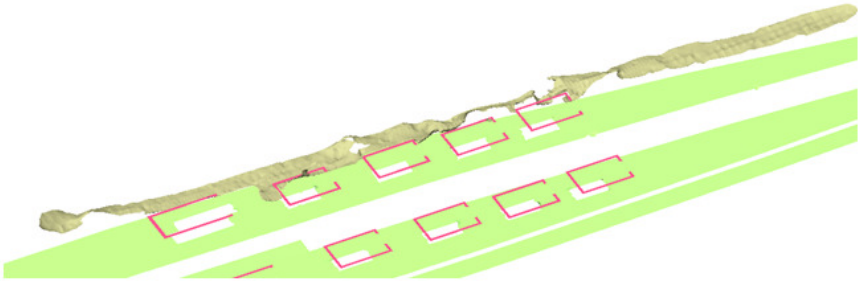
1.5 Minuten (Einschalten der Rauchentlüftung)



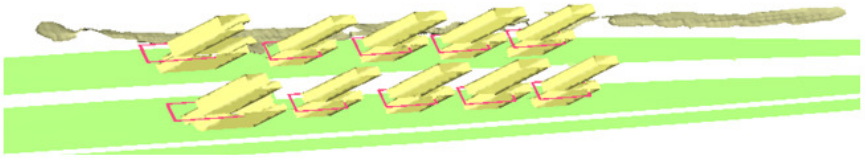
3 Minuten nach Brandausbruch



5 Minuten nach Brandausbruch

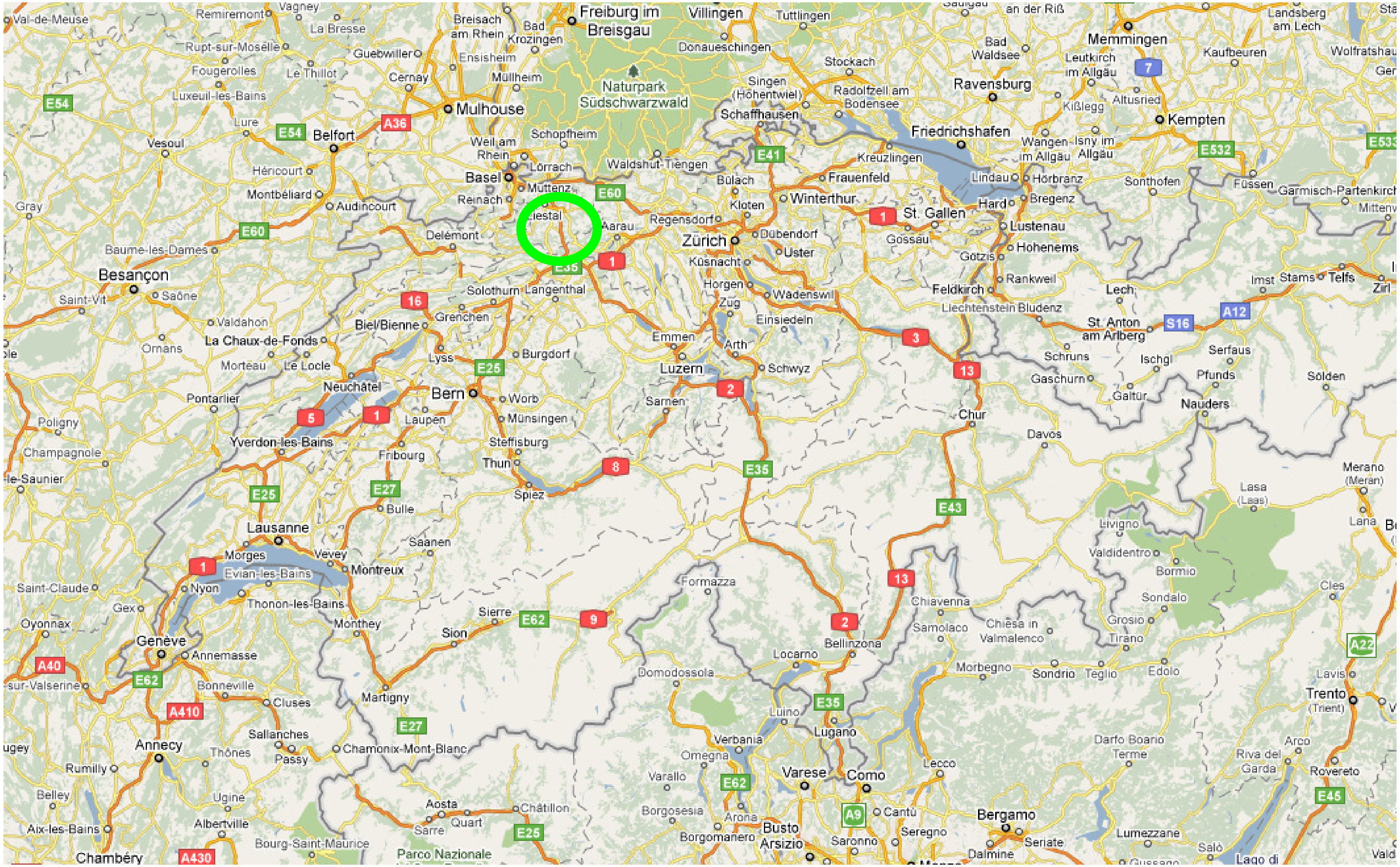


5:45 Minuten nach Brandausbruch





Tunnel Belchen

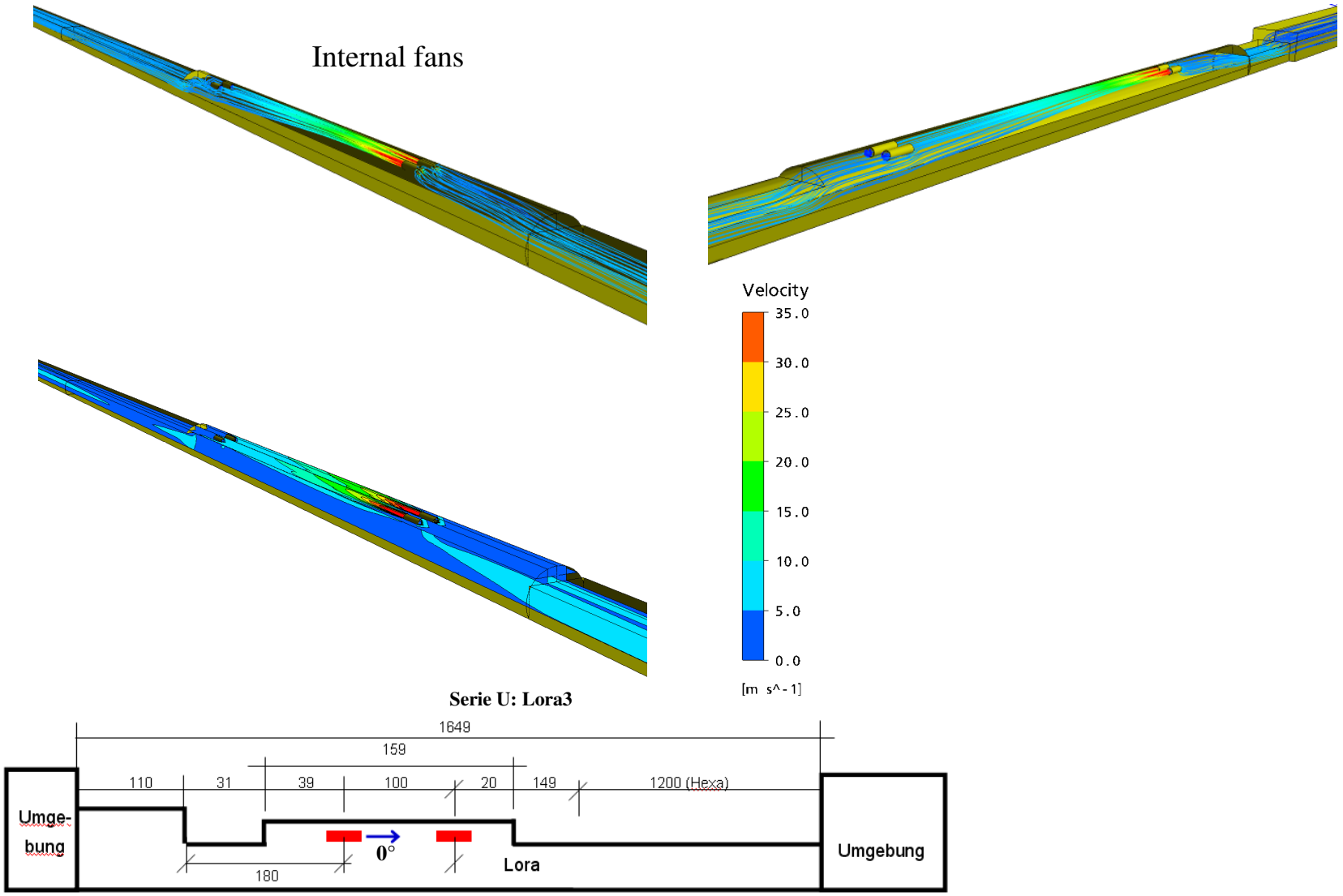


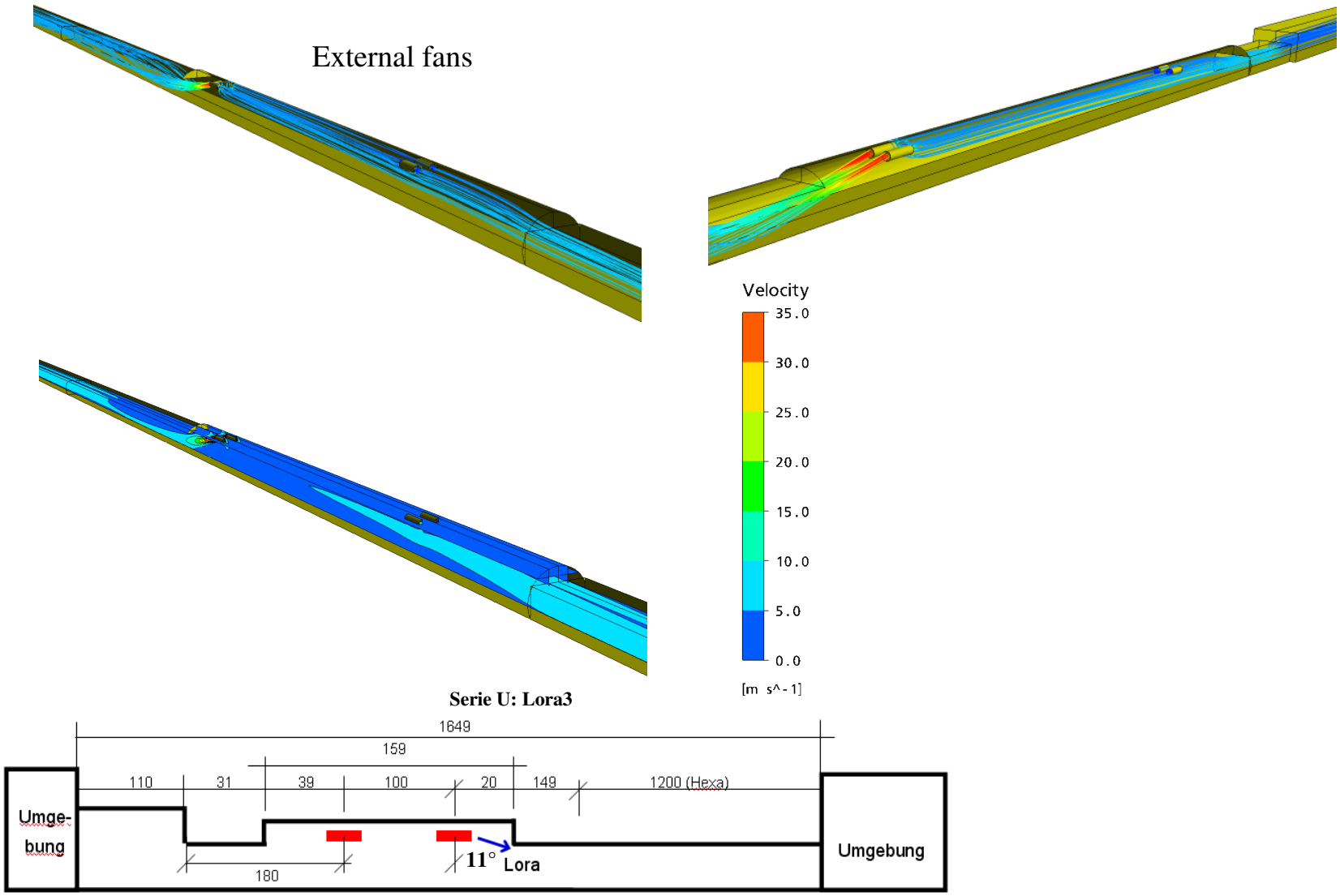
→3 Movies

Tunnel Sonnenberg

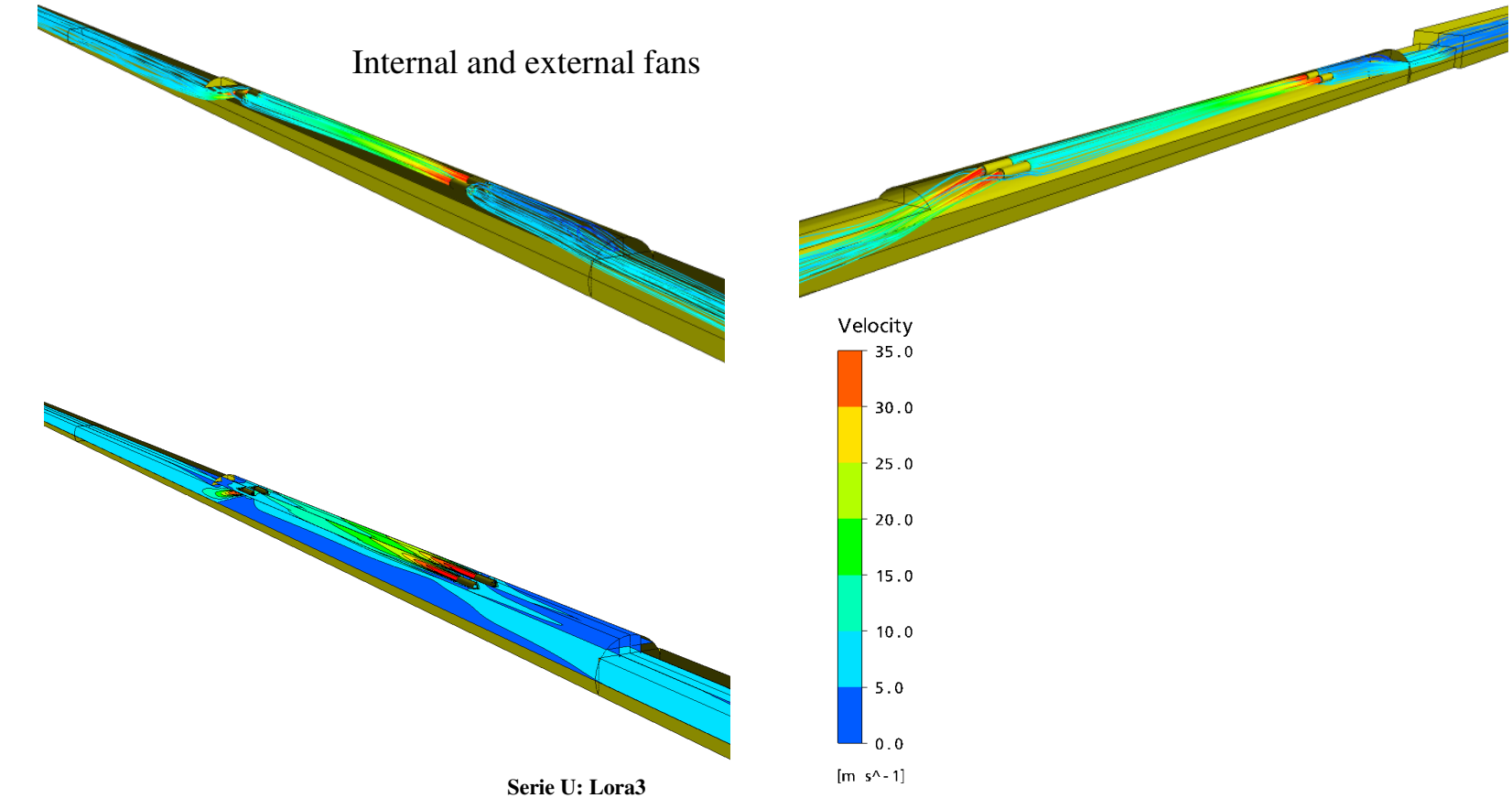


Analysis of entrainment of jet fans

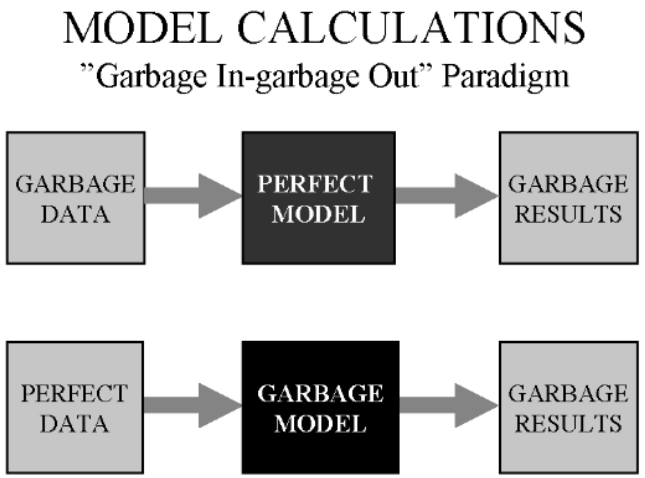


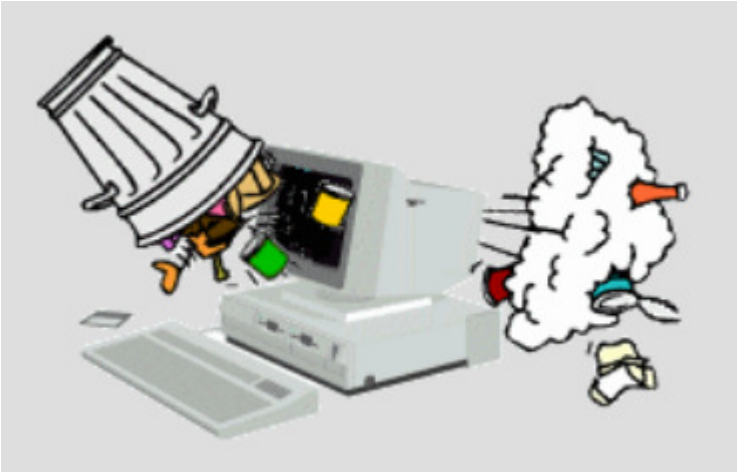

External fans
Velocity
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
[m s^-1]
Serie U: Lora3
1649
159
110
31
39
100
20
149
1200 (Hexa)
Umge-
bung
180
11°
Lora
Umgebung

Internal and external fans



Conclusions





- Numerical simulations (CFD) increase safety in tunnels and accuracy of tunnel ventilation devices
- Required know how (many years of experience) on
  - Fire safety
  - Physics, fire scenarios plausibility
  - Correct definition of boundary conditions
  - Numerical methods
  - Handling of CFD code
- AFC offers a good cost-benefit ratio
- Safety will increase with computer power (→Movie)