Extreme Weather in a changing Climate

Emerging Services to mitigate risks for the transport sector

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Outline

- Background – The need for tailored Weather services in a changing climate
- Characteristics of these services
- Natural Variability and man-made changes
- Scenario-based Risk management
- Operational Challenges

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Background

- **Existing Weather services**
  - Standard warning products: Severe Weather warnings, storm warnings, flood warnings)
  - Regionally and phenomena-dependent warning services:
    - Winter Weather- snow, freezing rain.
    - Tornado, Hurricane, Storm surges, Tsunami, Dust-and Sand Storms
    - Typically provided for national and regional authorities and the general /travelling public
  - Existing Gaps: Addressing the transnational nature of transport systems!

    (European projects addressing need for continent-wide linking of warning services for Trans European Networks, few similar approaches in other continents)

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Characteristics of services

Future weather (and climate) services to societal sectors such as Transport need to fulfill the following criteria:

- To be Accessible to all: Given the potential impact of climate variability on economic decision, this information must be openly available
- To be Driven by ongoing research and building on existing collaboration between the meteorological and transport communities dealing with chronic risks
- To provide Continuous improvement of forecasts in particular for specific regions and locations , and expressed in a clearly understandable way to decision makers
- Improving the range, availability and accessibility through exchange of data between research and operational agencies for the Earth, Atmosphere and Ocean system

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Increase in extremes

- Observations over the last decades reveal a tendency of increased extremes and unusually persistent weather patterns
- IPCC Assessments also point out to increased likelihood of extremes
- Recent extreme events (snow extremes over EU in 2009-2011, Floods in Central America, Pakistan, China) seem to support findings

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And still some do look rather surprised…

Photograph by John Giles/PA

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Validation Issue:

- Use of warning information in real-life decision making “requires a common understanding on how to evaluate and verify such highly complex predictions both from a modeling and user perspective “
  - How do we know that we got it right?
  - How can we know the answer is what the users were looking for?

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Risk Management Considerations

- Basics: Risk =Exposure x Impact
- Similar risks originate from high exposure but with lower impact, resulting to catastrophic events
- Political and economic decision makers often focus on mitigation of events of a return period within their terms of office
- Difficult to detect significant changes in many types of extremes due to limited observational information.
- Extreme events are rare by definition, and observational records thus are often not long enough

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Scenario-Based Risk Management

- Not based on average values
- « Critical Scenarios » to be identified
- Combined effects leading to desasters
  - Example: Strong precipitation associated with warm temperatures in spring over large mountains (snow melt and rainfall combine to high flood risk)
  - Storm Surge, high tides and heavy rainfall swelling river levels leading to coastal inundation
  - Extended droughts and high winds bringing high wildfire risk

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Operational Challenges to planning climate-resilient systems

- Transport infrastructure needs to account for climate uncertainties to enable more flexible responses to climate change
  - Off-shore structures and harbors need to be planned anticipating also sea level rises and changes in the severity and frequency of storms
  - Changes to maximum wind speeds would also influence the construction of road and rail bridges
  - Changes to permafrost soils have been carefully assessed and anticipated in the design of the new Tibetan railway line recently completed in China.

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Hurricane Dennis woz here

- Picture courtesy Government Fleet

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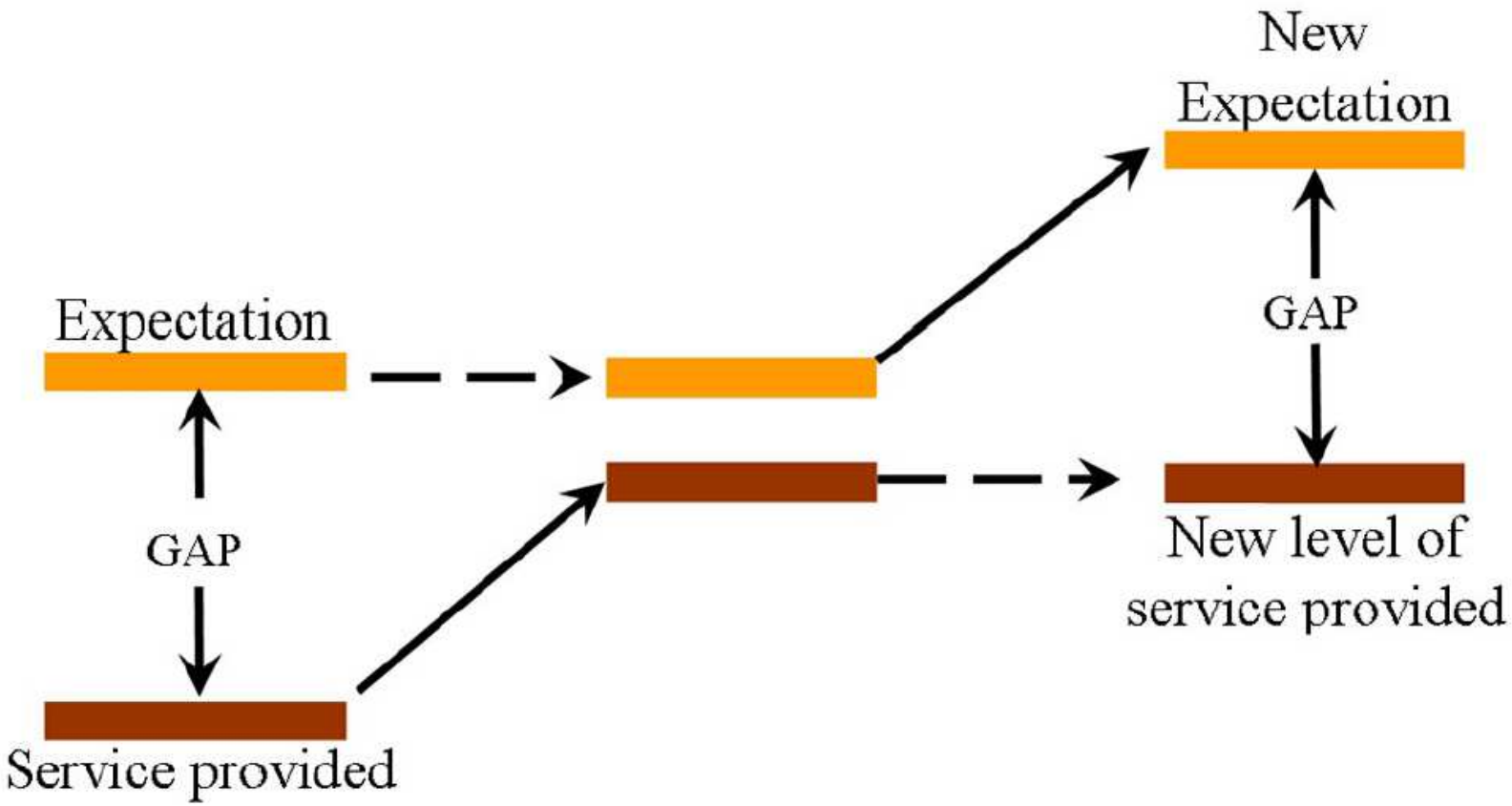
UNCERTAINTY IN WEATHER FORECAST



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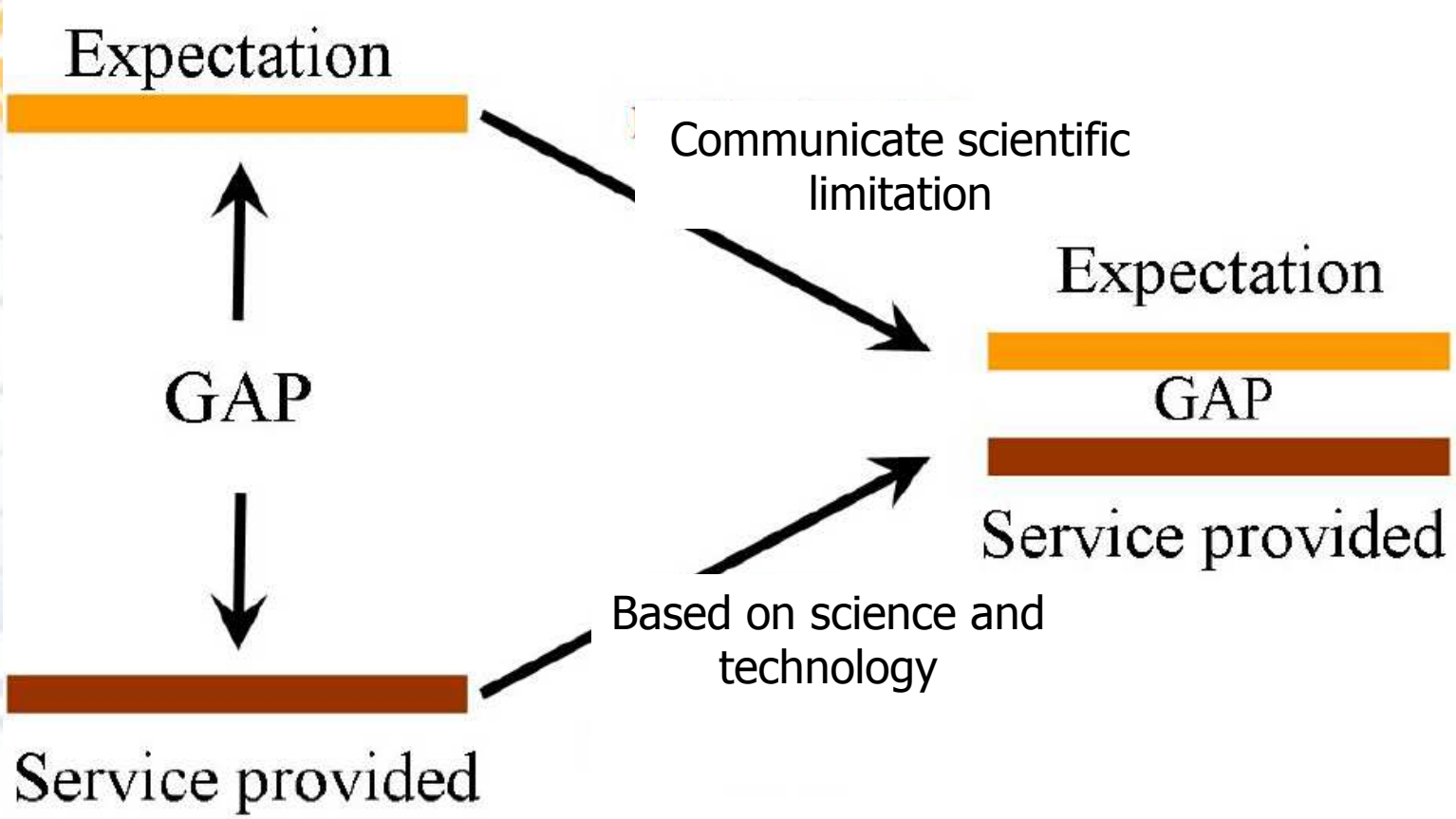

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Examples of specialized weather services in road transport

- Concentrate on high impact weather
- User interface built together with road/highway authority
- Mix of NWP, traditional nowcasting, and specialized nowcasting techniques for Temperature, Visibility, winds, surface conditions
- Push – and Pull-Systems co-exist

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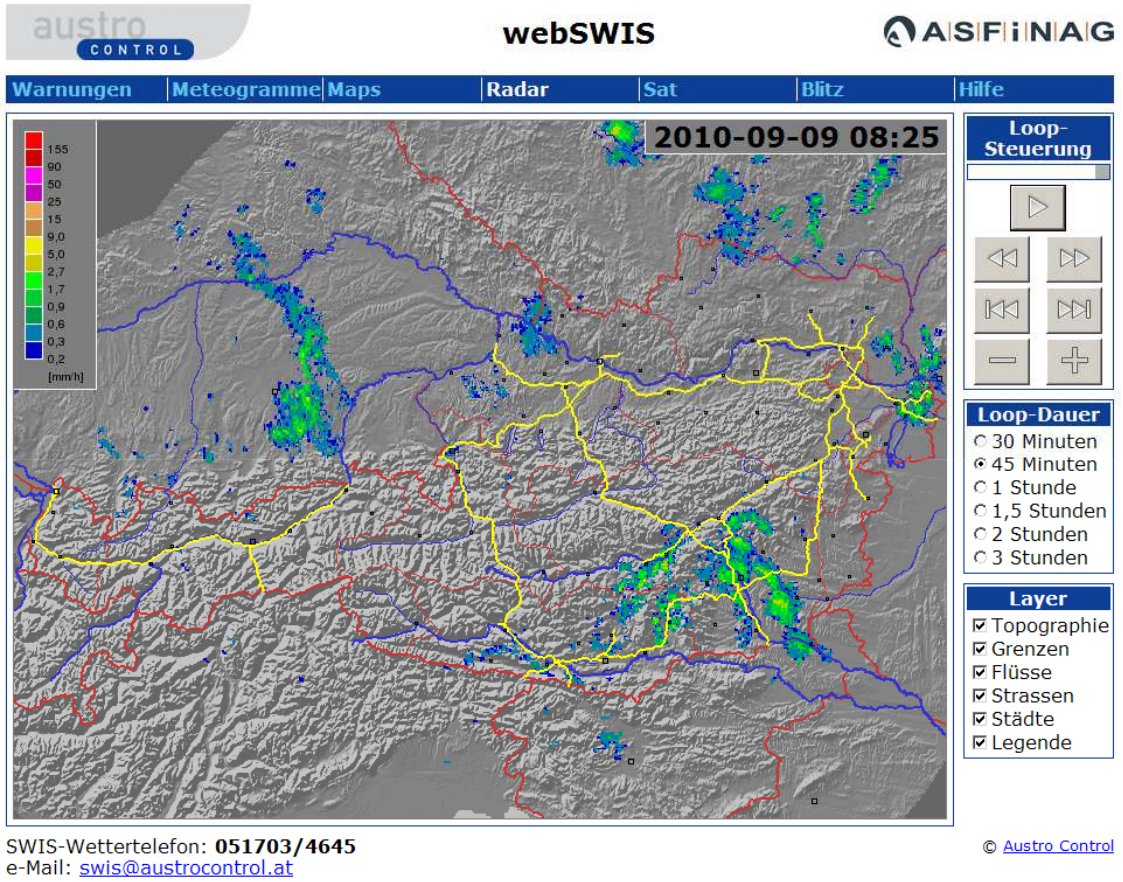
Central Europe: Austria



Radar composite Map with trunk highways overlayed

Surface Parameters, Tabular vs. graphics

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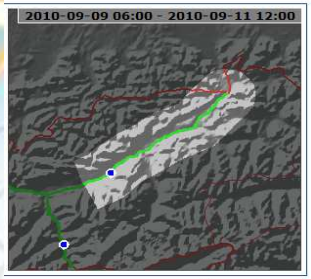
Warnungen | **Meteogramme** | Maps | Radar | Sat | Blitz | Hilfe



Meteogramm auswählen: Gesamte ABM

Wetterlage

Die Störungszone zieht nach Norden ab. Durch die Südwestanströmung bleiben Südstaulagen schaueranfällig.

Wetterentwicklung

Donnerstag, 09.09.2010:
Es bleibt weiterhin stark bewölkt mit leichten Regenschauern. Es kommt kaum zu brauchbaren Auflockerungen.

Nacht, 09/10.09.2010:
Stark bewölkt mit Regenschauern die von Norden her übergreifen.

Freitag, 10.09.2010:
Niederschläge vor allem entlang der Alpennordseite. Am Nachmittag zunehmend aufgelockert.

Nacht, 10/11.09.2010:
Die Nacht verläuft noch stark bewölkt aber größtenteils bereits niederschlagsfrei.

Samstag, 11.09.2010:
Im Tagesverlauf setzt sich auch in Tirol von Westen her Hochdruckeinfluss durch. Die Wolken lockern mehr und mehr auf und die Sonne kommt wieder zum Vorschein.

Druckansicht - Aufklappen

Vorhersage | SensorTabelle-Test | SensorGrafik-Test NS-Codes

Filter - **09.09.2010 08:37**

	Atmosphäre				Niederschlag		Fahrbahnoberfläche				Boden	
Alle abwählen	LT	TPT	RLF	SW	NS	NI	FBZ	WFD	GT	FBT	TT1	TT3
A12 - 0.737	11.9		100	2000								
A12 - 2.528	12.4	12.4	99	2000	0	0	0	0.02	0	13.6	14.3	18
A12 - 3.190					0	0	0	0	0	13.7	14.2	17.1
A12 - 5.365	11.4		99	2000								
A12 - 8.304	11.7	11.7	100	2000	0	0			0	13.2	14.2	17.5
A12 - 8.940					0	0	0	0.03	0	13.7	14.2	17.5
A12 - 38.678					0	0						
A12 - 38.854							0	0	0	13.5	14.9	18.4
A12 - 39.203							0	0.02	0	13.4	14.6	18
A12 - 40.060	12.7		98	2000								
A12 - 43.825	12.4	12.4	100	2000	0	0			0	13.3	14	17.7
A12 - 44.285					0	0	0	0	0	13.2	13.8	18
A12 - 50.351	11.6		96									
A12 - 56.265		10.9			0	0	1	0.06	0	13.3	14.4	18.8
A12 - 56.757	11.4		96	2000	0	0			0	13.3	13.9	17.5
A12 - 63.307					0	0	0	0.03	0	13.2	14.1	18.1
A12 - 63.666	12.4	11.3	92	2000	0	0	0	0.02	0	12.9	13.9	17.9

SWIS-Wettertelefon: **051703/4645**
e-Mail: swis@austrocontrol.at

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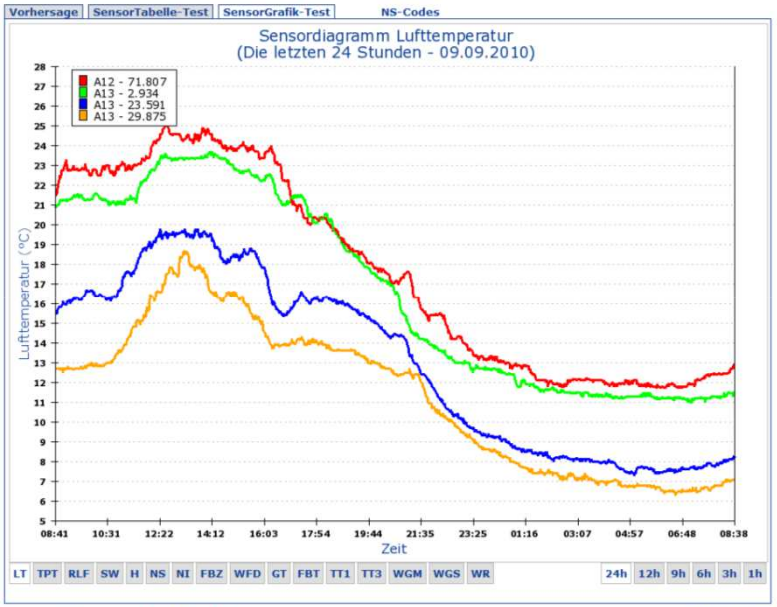

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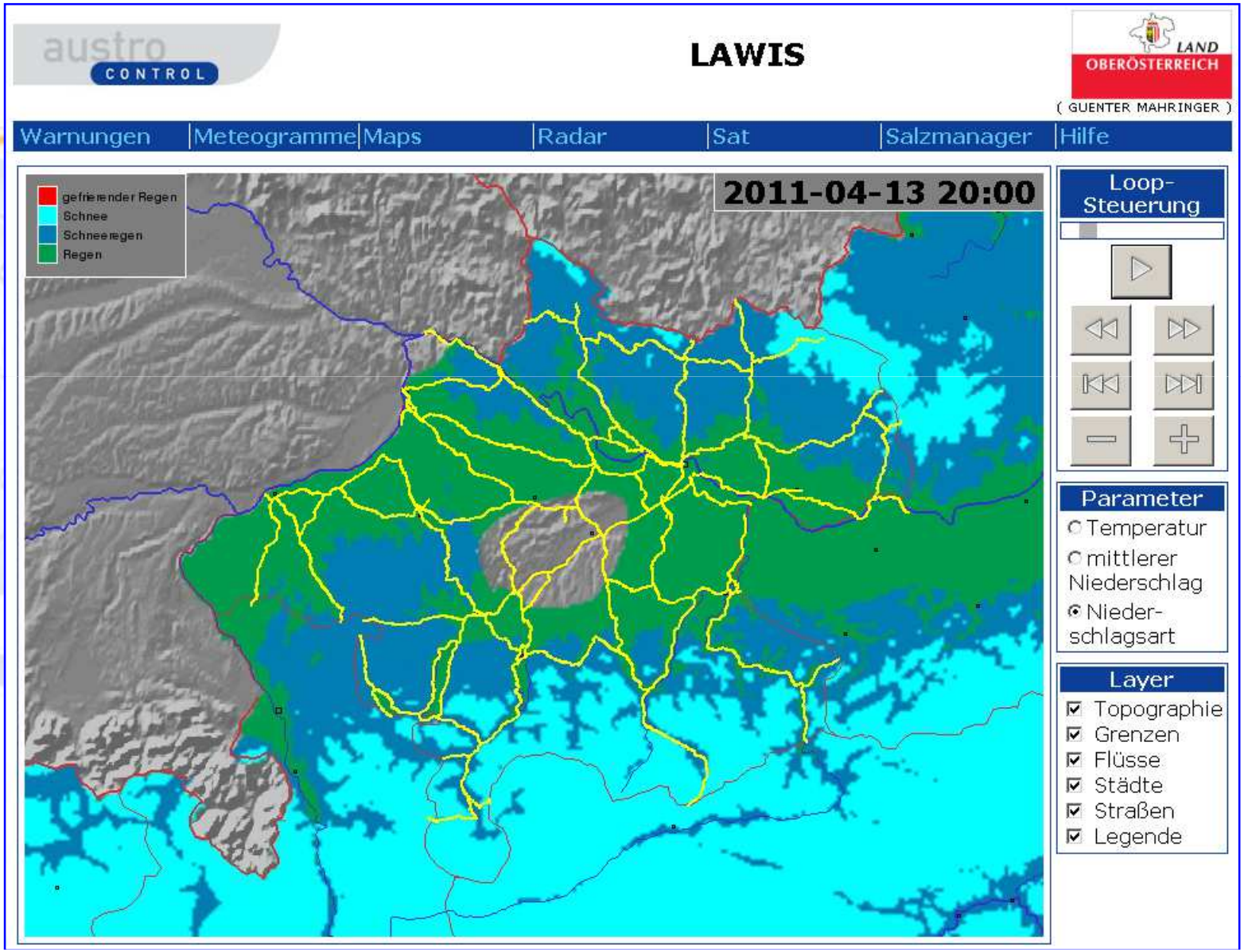
Critical values of Rel Hum highlighted in Red in Table

Winter Maintenance: Precipitation type – for type, amount and time of melting agent



Floods, Landslides, Surges

- Multi-disciplinary (Met, Hydro, Geology)
- Sometimes slow build-up, but very rapid "tipping" into catastrophic scenarios
  - Debris blocking flow under bridges (engineering)
  - Excessive rain de-stabilizing mountain/hill slopes

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Coastal Phenomena

- Storm Surges, Spring tides (Oceanography)
- Coastal erosion & Rainfall destabilizing coastal roads/rail
- High winds affecting exposed roads/rails/bridges (closures necessary, limitations for special vehicles)
- Extreme waves

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Semi-Arid /Arid Areas

- Sand-and Dust Storms –visibility, sand drifts, wandering dunes
- Bush Fires requiring closures
- Rail: Points affected by drifting sand
- Extreme heat – vehicle failures, rail deformation

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Conclusions

- Need for intense collaboration with user representatives to define requirements
- Use of user infrastructure and networks
  - Highway signalization, traffic alert system, mobile web applications
  - Optimization of highway/railway maintenance operations - large savings !
  - Sharing of network infrastructure e.g. road weather stations
  - Joint planning of network expansion/improvement for win/win situation

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Thank you

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