CIRED

Centre International de Recherche sur l'Environnement et le Développement

WEATHER

Economy- wide impacts

- Lessons of Weather Deliverable 1

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with

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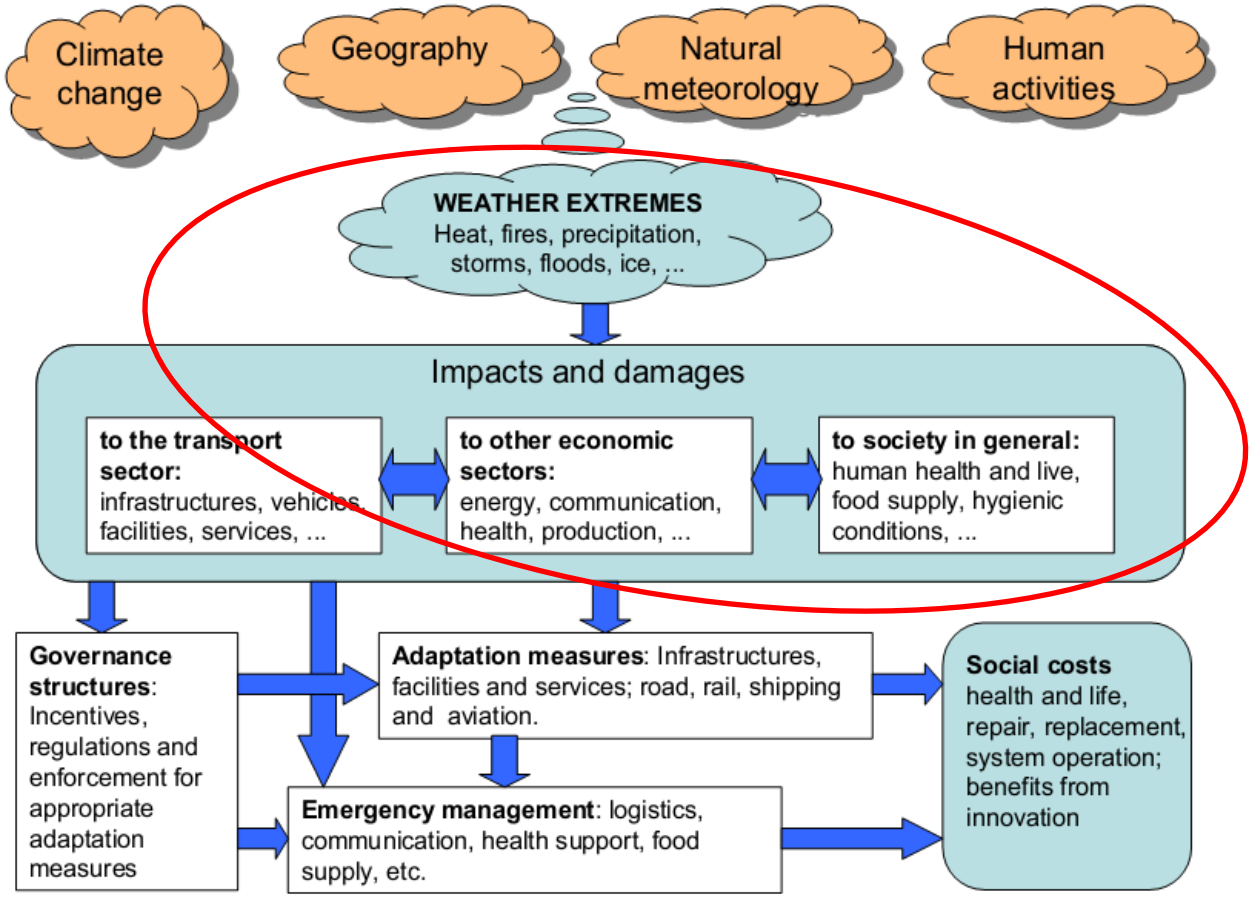
Outline

- Objectives of WEATHER WP1
- Methodology
- Results and Discussion

WEATHER AND « ECONOMY-WIDE LOSSES »



What are economy-wide losses?

- Economy-wide losses : losses in other sectors caused by the direct losses occured in the transport system

- Idea of « indirect costs» in the case of transport
  - Indirect costs : emergency costs, business interruptions, reconstruction costs, LT effect
  - Transport as public good is a particular « multiplier effect » : what is the extra amount of indirect costs that can be attributed to transport system failures?

Direct and indirect losses (from Hallegatte, 2008)

Direct losses:

- Casualties and injuries
- Direct economic losses (*i.e., value of what has been destroyed or damaged*)

Indirect losses:

- Emergency costs (Katrina: $8 billion)
- Demand surge (larger repair costs due to lack of workers and materials)
- Business interruption, supply-chain disruption, and propagations
- Lost production during the (long) reconstruction period
- Macro-economic feedbacks (e.g., through loss of jobs and tax revenue)
- Long-term adverse consequences on economic growth (developing countries)

Other costs:

- Political destabilization (developing countries)
- Psychological trauma and social network disruption

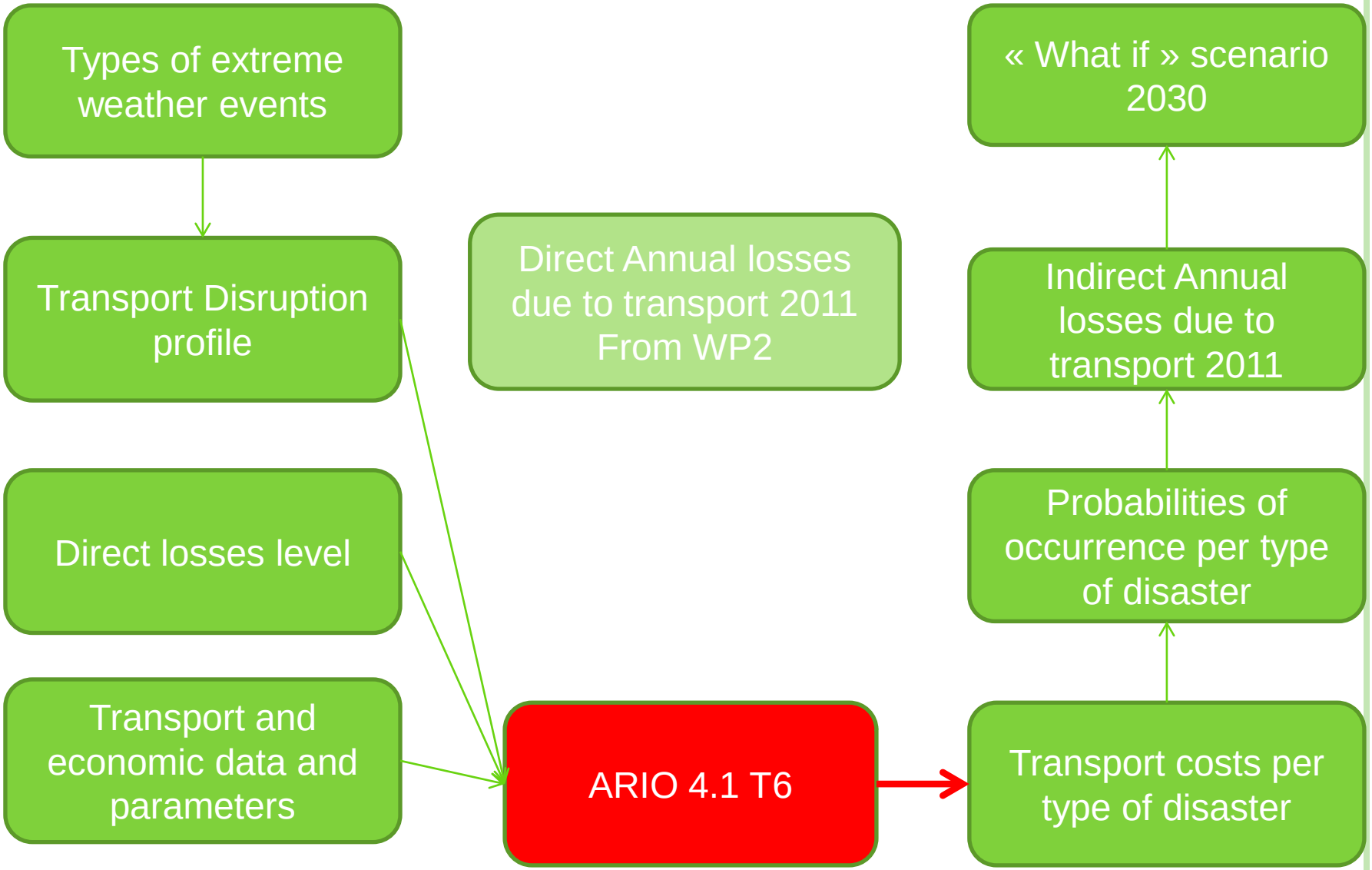
Indirect losses are highly nonlinear

OBJECTIVES

- Economy wide losses due to extreme weather related transport system failures
  - Annual losses in current situation
  - Climate change scenarios (2050, 2100) : frequency, intensity, types?
  - From meteorological indicators to macroeconomic indicators through physical constraint (transport system failures)

2. Methodology

and, Nowy Sacz 2010, Floods on railway bridge


Types of extreme weather events
Transport Disruption profile
Direct losses level
Transport and economic data and parameters
Direct Annual losses due to transport 2011 From WP2
ARIO 4.1 T6
« What if » scenario 2030
Indirect Annual losses due to transport 2011
Probabilities of occurrence per type of disaster
Transport costs per type of disaster

Assumptions related to the modelling exercise

- What is an extreme weather event (definition) ?
  - Functional point of view (disruption) vs. meteorological
  - Disruption profile (intensity / time)
  - 9 types of disasters profiles
- Questions of scale
  - Natural Disasters tend to be regional
  - They are of different types and of different location (european frequency)
  - Regional losses are also european losses (in absolute figures, not in VA losses…)
  - Stereotypical region : how to synthetize a regional economy?
- Climate change scenarios : how to consider CC?

METHODOLOGY

- Three baseline scenarios (without natural disaster) : no direct costs, 0,01% and 0,1%
- Indirect losses due to transport = Results with natural disasters – baseline (for each scenarios)
- Disruption profiles per mode of transport and substitution between modes as adaptation measure
- Annual losses computed with EM-DAT frequency: heavy being the highest 10%
- Sensitivity analysis…

Description of ARIO model

ARIO 3.0 (Hallegatte, 2008 on Katrina)

- Input-Output with flexibility between sectors (through prices)
- Reconstruction constraints (taken on normal consumption pattern) and specificity (types of sectors)
- Demande surge (and stimulus effect…)

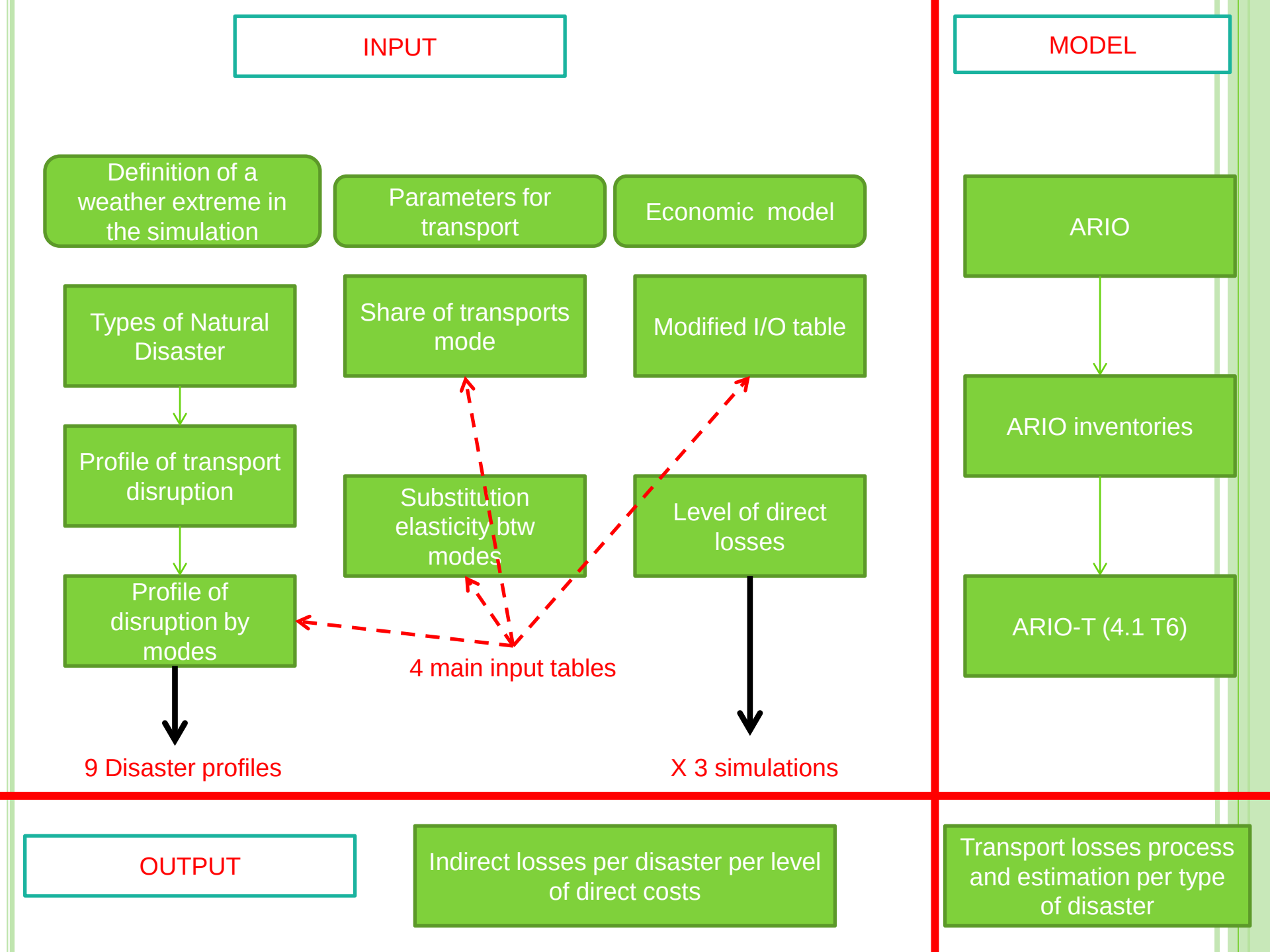
➢ Ripple effects across sectors through time : non linearity of indirect costs (/direct costs)

ARIO 4.0 (2011, developed for Weather)

- Shorter time-step
- Inventories as adjustment mechanism

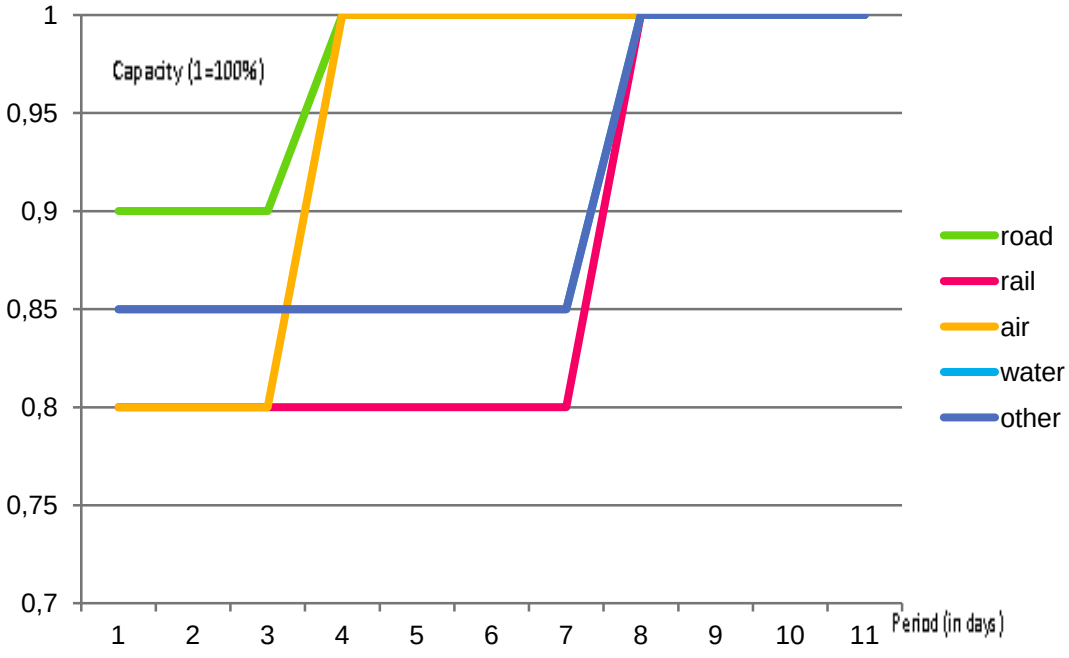
ARIO 4.1 T (2011, developed for Weather)

- Transport sector decomposition
- Introduction of transport constraints and adaptation mechanism
- Introduction of disaster profile for transport in the simulation of natural disasters


INPUT
MODEL
Definition of a weather extreme in the simulation
Parameters for transport
Economic model
ARIO
Types of Natural Disaster
Share of transports mode
Modified I/O table
ARIO inventories
Profile of transport disruption
Substitution elasticity btw modes
Level of direct losses
Profile of disruption by modes
4 main input tables
ARIO-T (4.1 T6)
9 Disaster profiles
X 3 simulations
OUTPUT
Indirect losses per disaster per level of direct costs
Transport losses process and estimation per type of disaster

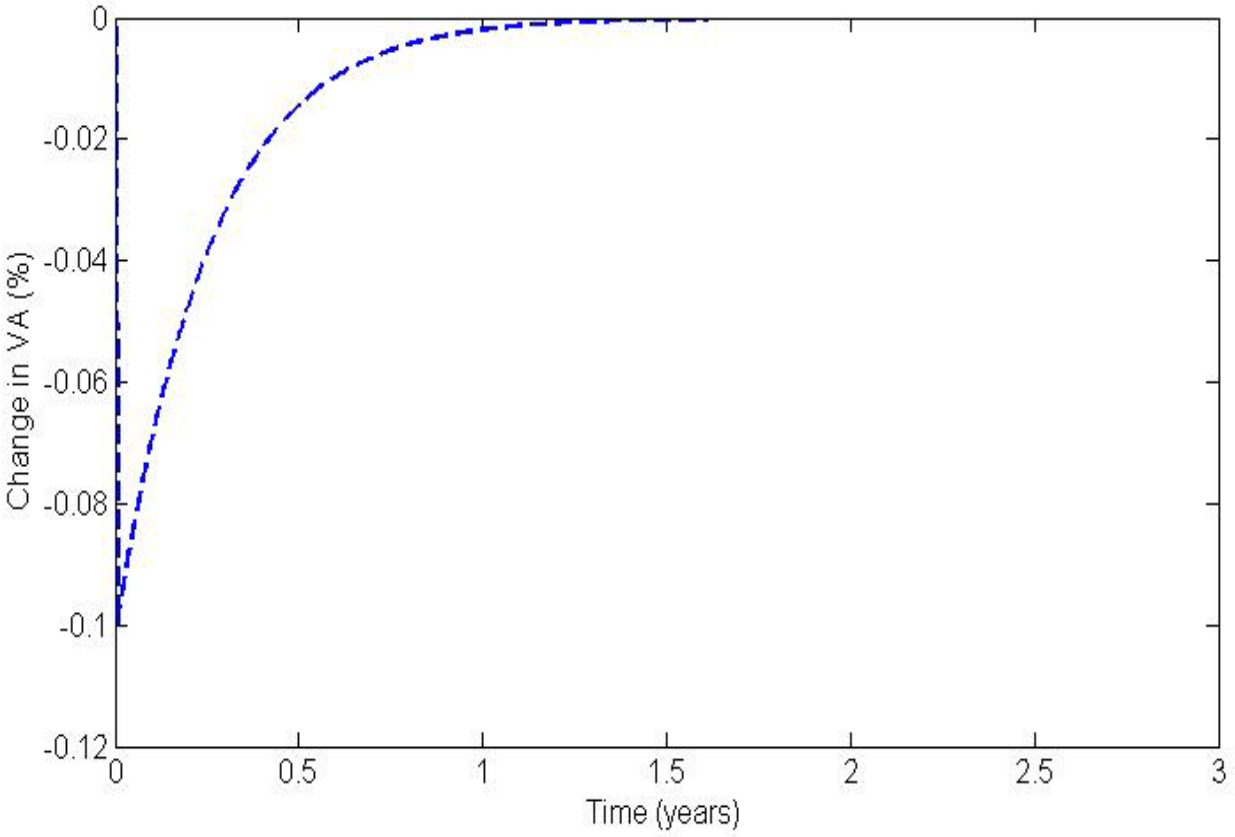
3. RESULTS

DISRUPTION PROFILE PER DISASTER



Disruption profile per transport mode through time – Disaster 2

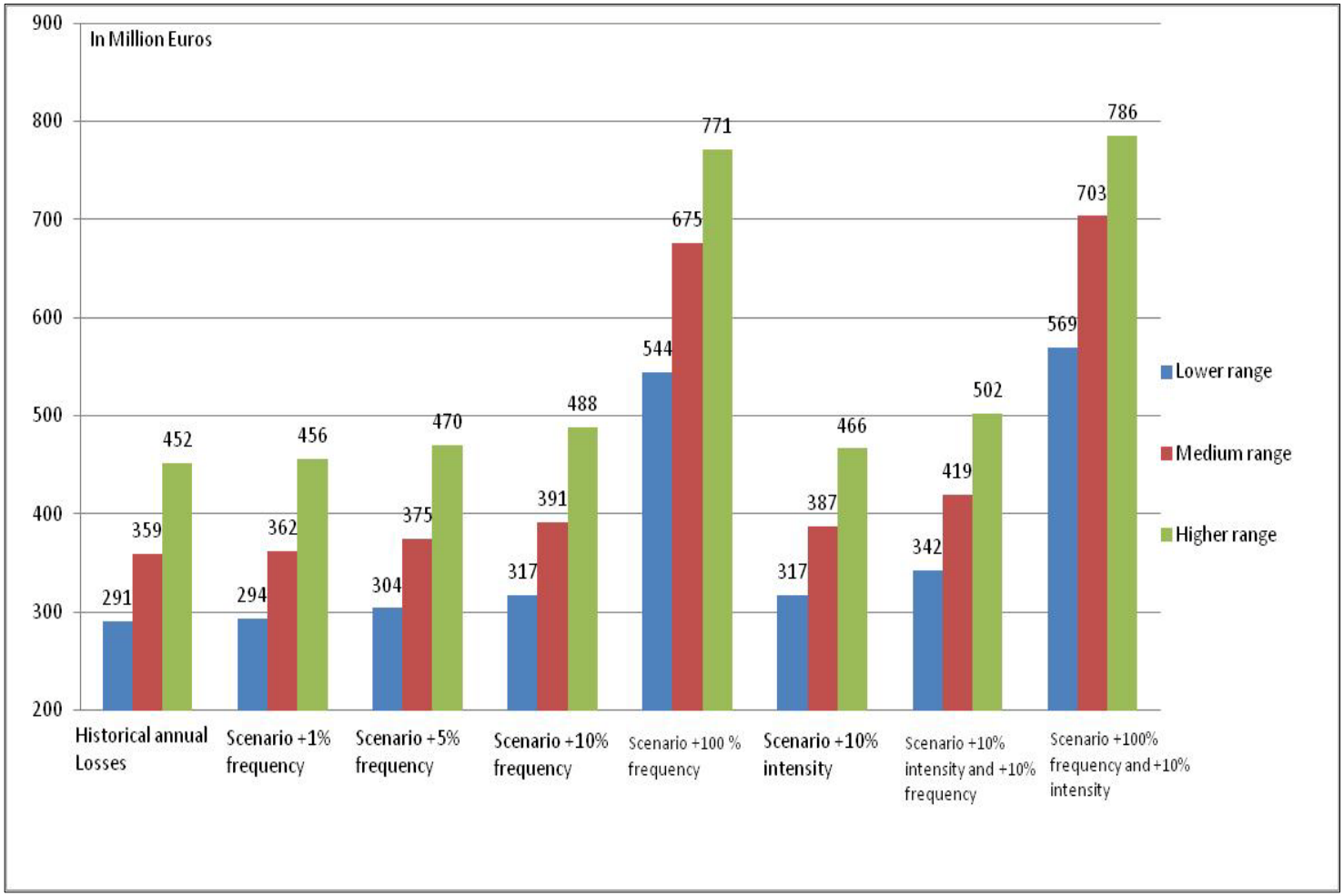
ARIO OUTPUT PER DISASTER TYPE



Annual losses per type of disaster = losses ario (disaster) x em-dat frequency

Type of Extreme Weather Event	Estimates of transport-related indirect costs, for three scenarios of direct costs, in millions Euros		
	Lower	Medium	Higher
Light Heatwave	0	0	0
Heavy Heatwave	18	19	20
Light Winter	0	0	0
Heavy Winter	0	0,090	0,159
Light Landslides/Alpine Hazards	9	9	70
Heavy Landslides/ Alpine Hazards	25	28	28
Light Flood	0	42	72
Heavy Flood	111	121	122
Storms	129	139	140
Total	291	359	452

CLIMATE CHANGE « WHAT IF » SCENARIOS



Discussion

- Limits
  - Limits of the main assumptions
  - Limits of the model
  - Limits of transport description in the model
  - Limits of current extremes description
  - Limits of the interface extreme events – transport disruption
  - Limits of climite change « What if »

→ these are clearly stated at each step of the modelling exercice : ARIO has not been overfitted, and intends to avoid being a « black box »

- Discussion

Thank you for your attention !

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APPENDIX A/ FROM DISASTER TO TRANSPORT DISRUPTION

Type of extreme	N°	Qualification	Description
	1	light	Uniforme reduction by 15% of capacity during 1 week
Heatwave (temperature + consequenc	2	heavy	Uniform reduction by 15% of capacity during 3 weeks
	3	light	Uniform reduction by 10% of capacity during 3 days
Winter (temperature + consequences	4	heavy	Uniform reduction by 40% of capacity during 1 week
	5	light	Reduction by 10% during three days, and then evolving from 2% to 0% in 6 months
Windstorms/Alpine Hazards/	6	heavy	Reduction by 40% during three days, and then evolving from 5% to 0% in 1 year
	7	light	Reduction by 5% during three days, and then evolving from 3% to 0% in 3 months
Floods	8	heavy	Reduction by 25% during three days, and then evolving from 10% to 0% in less than a 1 year
Storms	9		Reduction by 40% during three days, and then evolving from 5% to 0% in less than a year

APPENDIX B / SUBSTITUTION MATRIX

	Road	Air	Rail	Water	Other
Road	0	0,25	0,25	0,25	0,25
Air	0,1	0	0,1	0,1	0,1
Rail	0,2	0,1	0	0,1	0,1
Water	0,1	0,1	0,1	0	0,1
Other	0,1	0,1	0,1	0,1	0