





Earthquake, Landslide and Flood Disaster Prevention: the SciNetNatHaz project



Acknowledgments: 5 5 B O R D E R

The SciNetNatHaz Project is partially funded by the EU and Hellenic National funds within the context of the Black Sea Basin Joint Operational Programme 2007-2013

K. Papatheodorou, TEI of Central Macedonia, Hellas www.scinetnathaz.net









- Problems regarding flood disaster mitigation
- A brief description of the Project
- Outputs
- The SciNetNatHaz proposal for flash flood
 disaster prevention







A brief description of the Problems regarding Flood Prevention



2 REVENTION

PECOVERY





Common borders. Common solutions.

Hazard toDisaster!

ENOUS

PREATER Vulnerability & **Insufficient Capacity** to Reduce the RISK

- Unforeseen events
- Poorly assessed Hazard location and/or magnitude of events
- No preventive actions taken due to various reasons (economic, etc)
- Lack of public awareness
-and more







Hazard Assessment in the EU... the Information Gap!

- Usable Data are still lacking. Inventories of past landslides and floods do not exist or are not accessible.
- Metadata are not supplied so it's very difficult to assess reliability and accuracy of available data (if found).
- Different methodologies are used by scientists even in the same country, making comparison of results, impossible.
- Hazard identification & Risk assessment on a local scale (that could provide the essential information for planning preventive measures) has only been sparsely implemented.

isaster Applied Research (Implementation on a Local scale)

Risk Assessment

Hazard Identification







Some Flood related issues

- Serious problems regarding floods in large rivers are being tackled with early warning systems, preventive measures and management plans developed but...
- All though there is great advance in cross border flood management issues, there is still a lot to be done in terms of a common approach of the flood problem in neighboring countries.
- Flash floods, which are frequent and common in most of the Mediterranean and the Black Sea countries, are not dealt with. This fact has already been recognized by the EU and flood management plans are foreseen to be designed during the next period of the Directive 2007/60/EC implementation.







28-VENTION

PREPREDNESS

BNO85

Common borders. Common solutions. What needs to be done

CONSENSUS (a pre-requisite!) among the members of the scientific community involved in ELF Disaster mitigation regarding:

- Harmonization of METHODOLOGIES used to assess the hazards...in order to create a large network of potential partners working on the same problem, supporting each other, sharing competencies.
- **DATA harmonization** including **METADATA** creation.
- DATA collection and SHARING
- Applied Research to provide support for decision making
- A way to overcome the problem of needing....Time and Money! (for data collection and processing)







A brief description of the SciNetNatHaz Project







The Parthership!





DEMOCRITUS University of THRACE, Greece

Institute of Engineering Seismology & Earthquake Engineering,



"Assen Zlatarov" University BULGARIA



OVIDIUS

University

ROMANIA







BSB, Environ-Acad. of Sciences mental Academy of Sciences



Bogazici University-Kandhili Observatory & Earthquake Research Institute, TURKEY

EPPO ЕРРО

MOLDOVA

UKRAINE

UKRAINE

tute, TURKEY

Areas of investigation

Basic Info:

Black Sea Basin Joint Operational Programme 2007-2013

Duration: 31 months Total Budget (ENPI + IPA): 1.053.000,00 Total Grand (ENPI + IPA): 947 700,00 Start - End Dates: 01.05.2013 - 30.04.2015









Scope of the SciNetNatHaz Project



- A. To establish a strong regional (BS) cooperation by developing a SCIentific NETwork for Earthquake, Landslide and Flood (ELF) Hazard Prevention that will set the basis for:
- **B.** Systematic data acquisition, harmonization, management and sharing with the scientific community
- C. Harmonization of Methodologies and Procedures used to assess ELF hazards
- D. A systematic Hazard assessment Pilot implementation in selected areas so that preventive measures can be proposed







...some of the results (so far) #1

- A. More than 80 Scientists are already participating in the Project coming from 12 different Universities, Academies of Sciences and Research Institutes around the Black Sea area. More scientists have expressed their interest in being voluntarily involved in the implementation phase.
- B. Topographic and Thematic maps in analogue and digital format, digital and tabular data were collected, processed and Metadata files created according to the INSPIRE directive (around 1000 files).
- A **Geodatabase** has been developed as part of a WeGIS which hosts both data and Results produced by the Project.
- A **Web GIS platform** has been developed and is already operational. It will provide data and pilot implementation results to stakeholders.
- **Open source software has been adopted** for all applications in order to be freely shared with the stakeholders.
- Open Seminars are being scheduled for the next months.







...some of the results (so far) #2

- **C.** Harmonized Methodologies selected/adapted to local conditions are proposed and are being used for ELF Hazard assessment throughout the implementation area.
- Pilot Implementations of Flash Flood Hazard assessment/Design of Preventive measures, have already been carried out in Greece, in Romania, in Turkey and in Bulgaria (under implementation).
- More than ten Presentations in International Conferences and six Paper Publications in Scientific Journals have already been supported by the project. Publications are being made in order to communicate the Project Outputs (and funding source & Programme) with the stakeholders –especially the Scientific Community and practitioners-and receive feedback.







The SciNetNatHaz proposal for flash flood disaster Prevention







Problems and Solutions

- Usatle Developil a methodology with minimal data landslides and filods not exist or provide accurate and reliable
- results to support decisions regarding designing to assess reliability PREVENTIVE MEASURES data (if found).
- Different n2: Bilot Implementations on a "Sitescale)
 Specific"/Engineering scale in order to evaluate
- Hazard identification & Risk ass Hazard Identification
 Iocal scale (that could provide the essential inf3...Share competencies/Build Capacity of the Stakeholders to broaden the number of users







Flash Flood Hazard (FHA) Assessment -Methodology (Model) selection Considerations

Sequential Steps for Model selection:

- **1. Problem** definition;
- 2. Specification of the **objectives**;
- **3.** Evaluation of the available data;
- 4. Determination of the **available** computer/hardware **facilities**;
- 5. Specification of economic & social constrains;
- 6. Adoption of a particular class of hydrologic models;
- 7. Selection of the particular **type of model** within a selected class;
- 8. Model Calibration/Adaptation to local conditions;
- 9. Performance evaluation;
- **10**. Potential use of the model for prediction purposes;
- **11**. The possibility of embedding the specific model into a more general one.

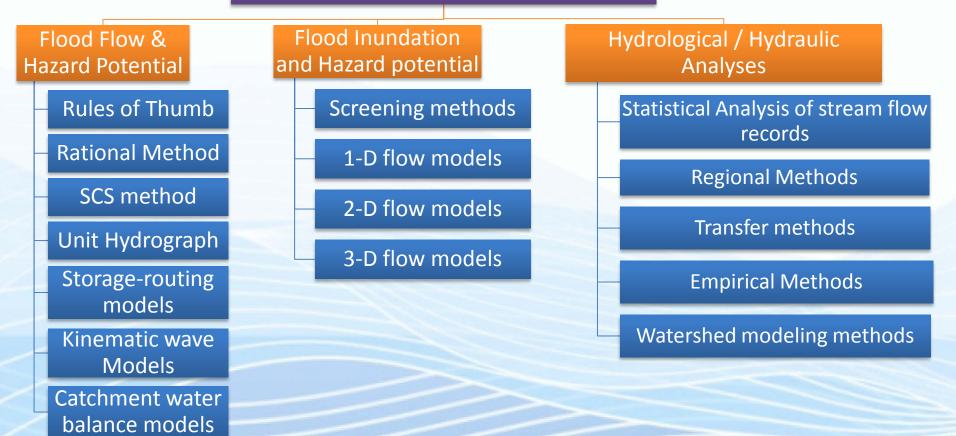






Flood Models, Methods and Techniques considered

Methods / Models classified





Evaluation





Common borders. Common solutions.

Evaluation criteria (a brief list)

Data requirements

User friendliness

Flexibility/Adaptability

Cost of implementation

Watershed Representation

Completeness

Reliability

Accuracy

Evaluation of Outputs

Feasibility to

implement







The SciNetNetHaz "two step" proposal 1st Step: SCREENING! Using Morphometric models to locate Flood prone areas Assess the potential risks and prioritize research Second Step: Implementation on a local scale

Lusing Hydraulic models to assess flooding parameters and design preventive measures

3. Use Open Source Software for the entire process and disseminate to promote adoption by the stakeholders (Public Sector, practitioners, scientists)







Step 1:

Common borders. Common solutions.

Using Morphometric models and Open Source Software to locate Flood prone areas

A guide to pilot Implementation







Contents

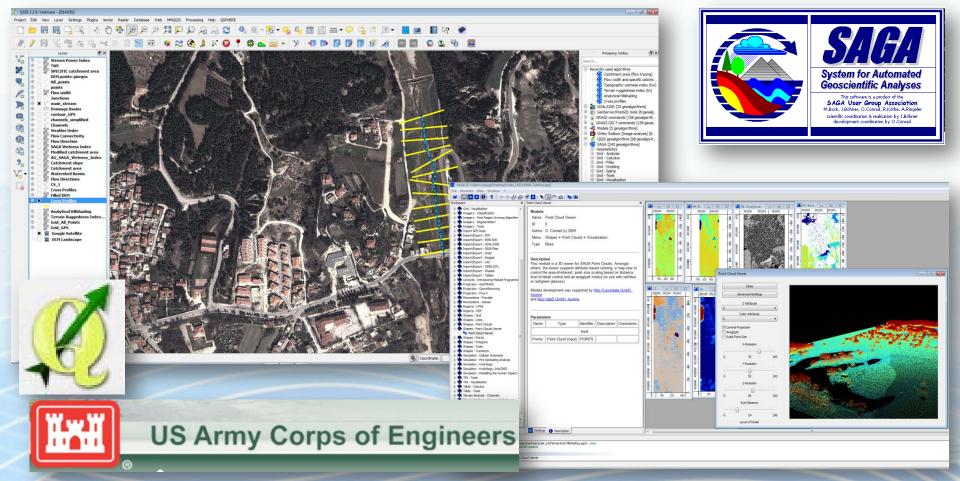
- Data Requirements
- Procedures
- Outputs
- Evaluation







The Tools – Open Source software









Regional Scale assessment: Required Data

Topographic Maps, scale 1:50.000

This is compulsory; the rest are optional

Elevation Points

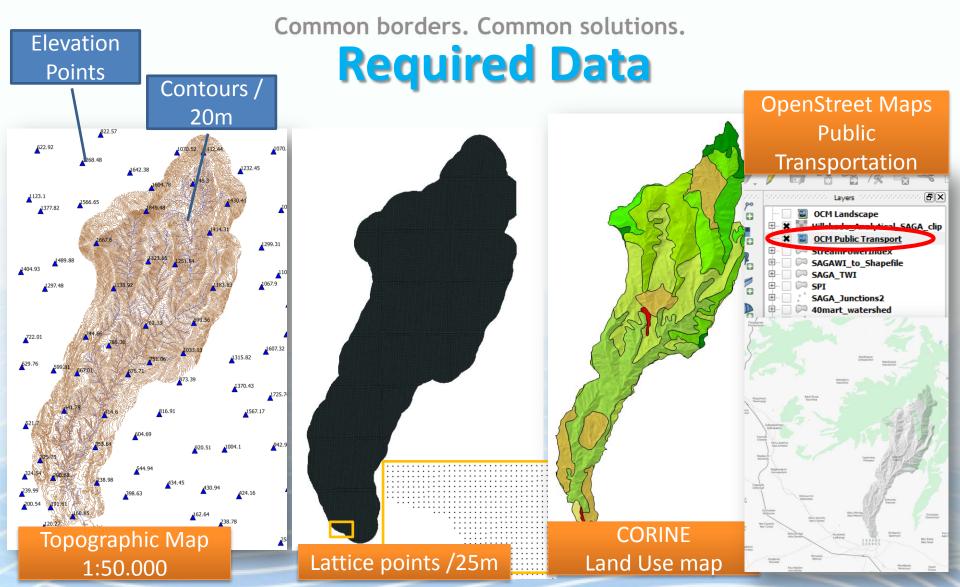
Land Use maps (Corine 2000 / 2006)

Road and Railroad Network









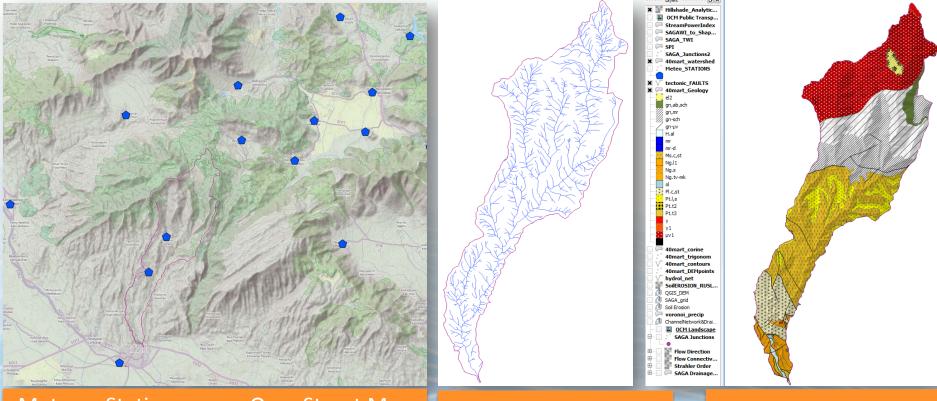






Rainfall & Hydrology

Please Note: Rainfall data are compulsory for the implementation on a local scale



Meteo – Stations on an OpenStreet Map Landscape layer

Hydrology Network (digitized from topo maps)

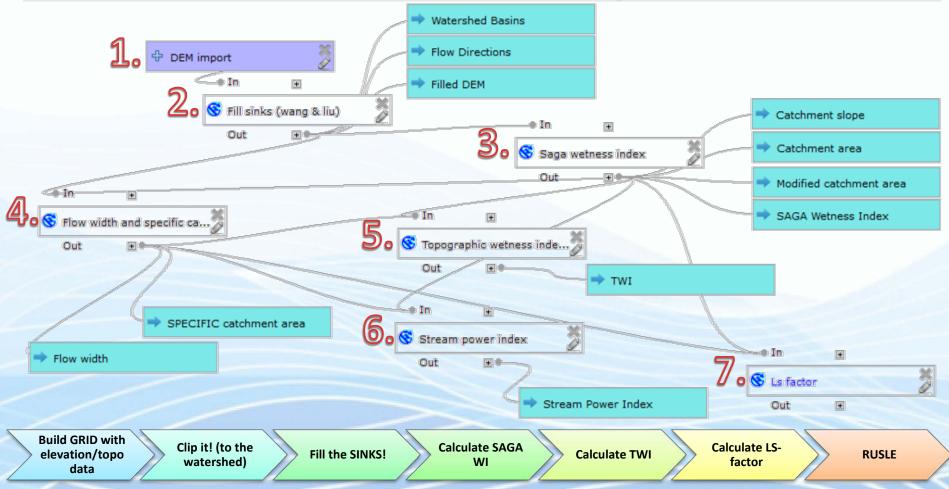
Geologic map







Procedural steps

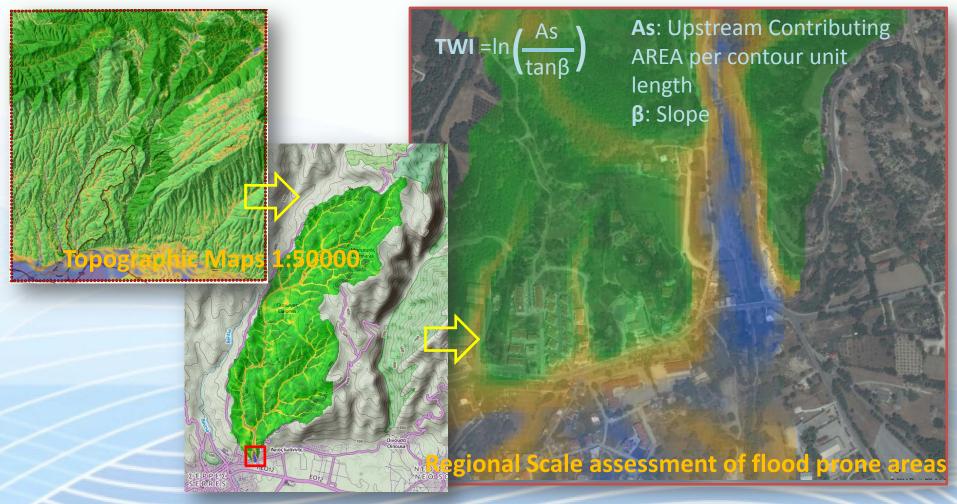








Flood Hazard... Screening from Regional to Local scales

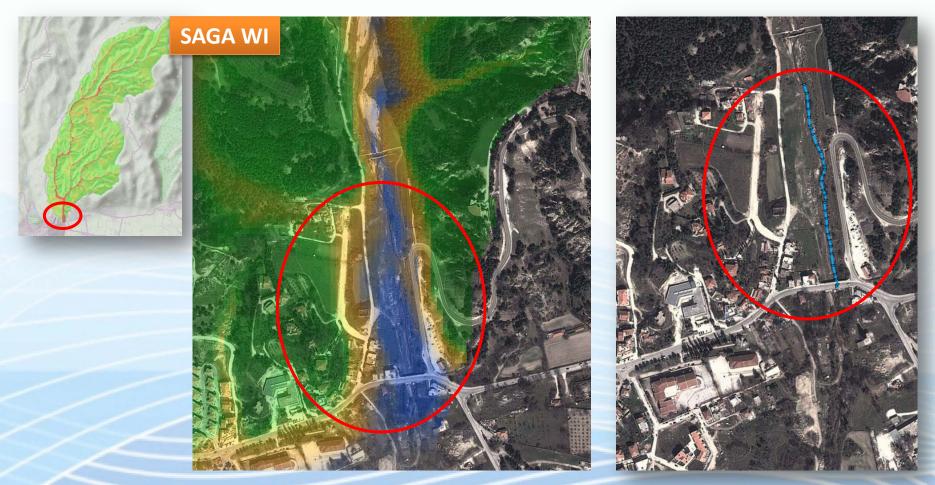








From Regional to Local Scale

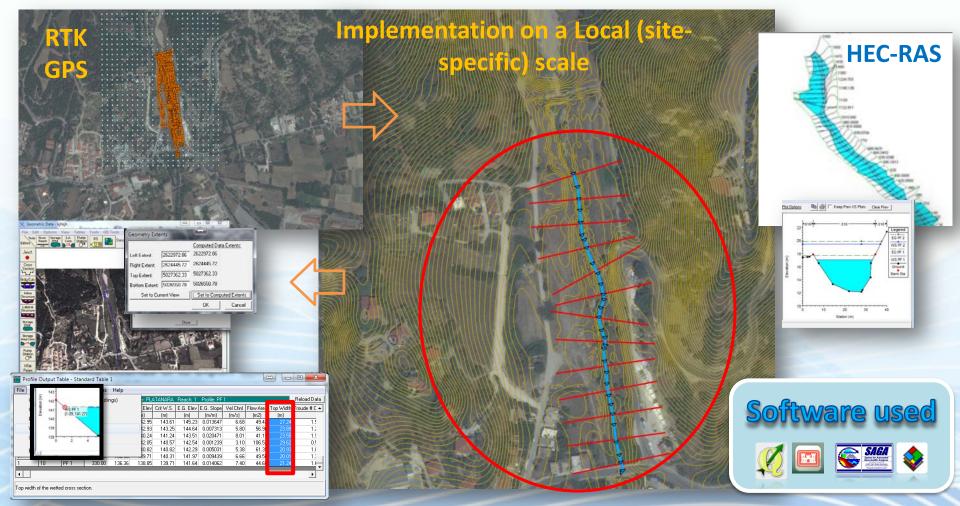








Flood Hazard on Local scales – Hydraulic Models (HEC-RAS)





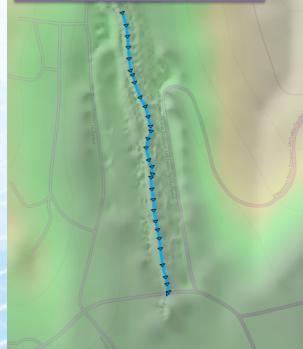




Cross Sections – Output to HECRAS

(local scale implementation)

Requirements 1. DTM 2. STREAM (digitized towards downstream)



QGIS 33 GE3 7 COMMANUS | 130 GEOA dels [5 geoalgorithms] eo Toolbox (Image analysis) [8. 🗄 💋 QGIS geoalgorithms [68 geoalgorit. 🖻 🔇 SAGA [243 geoalgorithms] Geostatistics Grid - Analysis . Grid - Calculus 💋 Cross profiles X . ⊕ Grid - Filter DTM Stream E Grid - Gridding 🗄 Grid - Spline Parameters Log Help ⊞ Grid - Tools . ⊕ Grid - Visualization Imagery - Classification DEM 🗄 - Imagery - RGA Grid All Points [EPSG:2100] • Imagery - Segmentation 🗄 Imagery - Tools Lines ⊞ Recreations -2 main_stream [EPSG:2100] 🗄 - Shapes - Grid E Shapes - Lines Profile Distance **Distance between profiles** E Shapes - Polygons 25.000000 Shapes - Tools ⊞ Shapes - Transect **Profile Length** Profile Length E Simulation - Hydrology . Table - Calculus 50.000000 **-** ⊡ Table - Tools Terrain Analysis - Channels **Points per Profile** E Terrain Analysis - Hydrology Profile Samples ÷ Terrain Analysis - Lighting Terrain Analysis - Mornhomet **...** 10.000000 Terrain Analysis - Profiles 😴 Cross profiles Cross Profiles 😵 Profiles from lines [Save to temporary file] . ⊡ ··· Vigra X Open output file after running algorithm <u>ع</u>... Scripts [14 geoalgorithms] File Name of Cross Sections 🗄 🔀 Tools for LiDAR data [42 geoalgorit. 0% Run Close Cancel





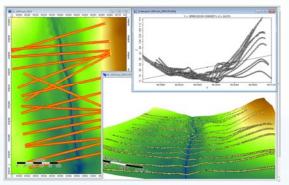


Cross Sections – Output to HECRAS Filled DEP Ē Cross Profiles × ÷. Analytical Hillshading ÷ Terrain Ruggedness Index... Map Attribute Table (elevation per point) table - Cross Profiles :: Features total: 13, filtered: 13, selected: 0 0000 ? LINE PART X000 X001 X002 X003 X004 X005 X006 0 0 81.31216345 81.01318737 80.77740383 81.94197267 77.05189802 76.69844410 77.05443992 78 1 2 81.22395998 78 0 0 80.36807859 80.53721828 81.06987561 77.57384116 76.87042625 76.97116680 7 3 0 80.09556574 77.92777418 75.89942276 74.94321184 0 79.41675102 79,48167429 76.79975725 4 0 0 76.66154973 77.76394551 79.05340228 78,59009320 76.49035852 74.47164445 76.77079476 78 5 0 0 77.80336311 77.37470877 78.16067886 75.46817292 76.80625927 74.02599430 80.54654084 7! 6 77.34242100 76.66835280 74.61941307 74.38077634 7 0 0 76.73347127 74,92638915 80.26241746 7 0 0 77.80927850 76.68323782 76.14639791 76.07710368 75.01390560 74.42291312 75.13211237 79 78 8 0 0 77.23749681 75.90792673 75.72605607 76.68124969 73.87090896 74.31871114 75.77795388 7 9 0 0 76.55099047 76.18423905 75.55665144 75.24518147 74.32255786 73.49378710 74.02076655 10 0 73.62798108 73.46479715 76 0 73.85383254 73.31347786 74.90021990 72.95154047 73.71524203 11 0 0 74.68907417 74.15059204 74.05358555 74.13774337 73,45784859 73.19855870 73.83427092 7! 12 0 0 75.14858686 74.18871763 72.67972298 72.79477218 72,78129420 72.28222858 74.62984865 7! 13 0 0 74.83953867 74.12967483 72.99763645 72.37374664 72.17354573 72.12532994 75.62717616 7! 4 🕨 Features

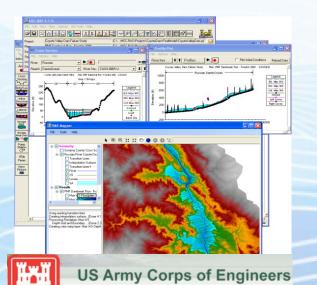








Please click here to see the "how to" create cross sections tutorial



Please click here to see the "how to" assess the flooding parameters using the HEC-RAS software







Some Technical Issues follow...

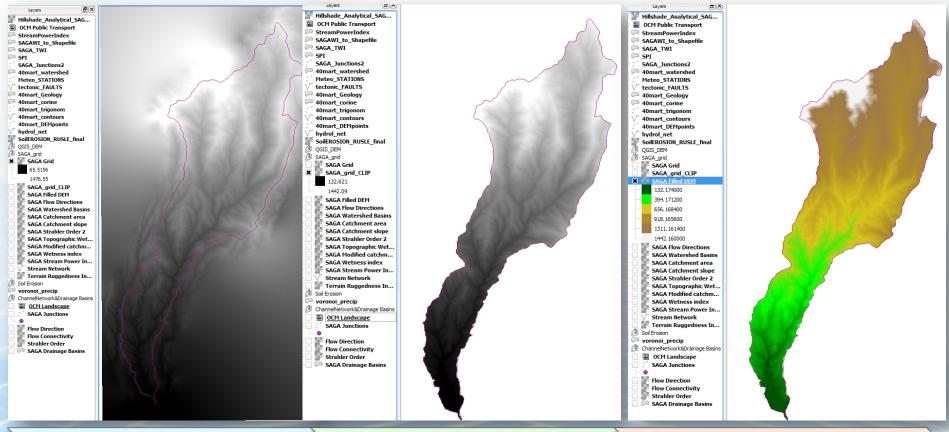
...12 slides showing "how to" locate flood prone areas on a Regional scale but can be skipped to save time!







GRID Related Processes



Build GRID with elevation/topo data

Clip it! (to the watershed)

Fill the SINKS!







GRID Related Processes – Fill Sinks

Description

This module uses an algorithm (Wang & Liu, 2006) to identify and fill surface depressions in digital elevation models. The method was enhanced to allow the creation of hydrologic sound elevation models, i.e. not only to fill the depression(s) but also to preserve a downward slope along the flow path. This is accomplished by preserving a minimum slope gradient between cells. This is the fully featured version of the module creating a depressionless DEM, a flow path grid and a grid with watershed basins.

References

Wang, L. & H. Liu (2006): An efficient method for identifying and filling surface depressions in digital elevation models for hydrologic analysis and modeling. International Journal of Geographical Information Science, Vol. 20, No. 2: 193-213.

H- Terrain Analysis - Channels Burn stream network into d... Catchment area (flow traci... Catchment area (mass-flux... Catchment area (parallel) Catchment area (recursive) Cell balance Edge contamination Fill Sinks Fill sinks (wang & liu) Fill sinks xxl (wang & liu) Flat detection Flow path length Flow width and specific cat... Lake flood Ls factor Saga wetness index Sink drainage route detection Sink removal Slope length Stream power index Topographic wetness index... Upslope Area







×

REFERENCES

Common borders. Common solutions.

SAGA Wetness Index

SAGA Wetness Index

Module

Name	SAGA Wetness Index	

ID 15

Author (c) 2001 by J.Boehner, O.Conrad

Menu Terrain Analysis > Hydrology > Topographic Indices

Type Grid

Description

The 'SAGA Wetness Index' is, as the name says, similar to the 'Topographic Wetness Index' (TWI), but it is based on a modified catchment area calculation ('Modified Catchment Area'), which does not think of the flow as very thin film. As result it predicts for cells situated in valley floors with a small vertical distance to a channel a more realistic, higher potential soil moisture compared to the standard TWI calculation.

References

- Boehner, J., Koethe, R. Conrad, O., Gross, J., Ringeler, A., Selige, T. (2002): Soil Regionalisation by Means of Terrain Analysis and Process Parameterisation. In: Micheli, E., Nachtergaele, F., Montanarella, L. [Ed.]: Soil Classification 2001. European Soil Bureau, Research Report No. 7, EUR 20398 EN, Luxembourg. pp.213-222.

Parameters

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SAGA Wetness Index

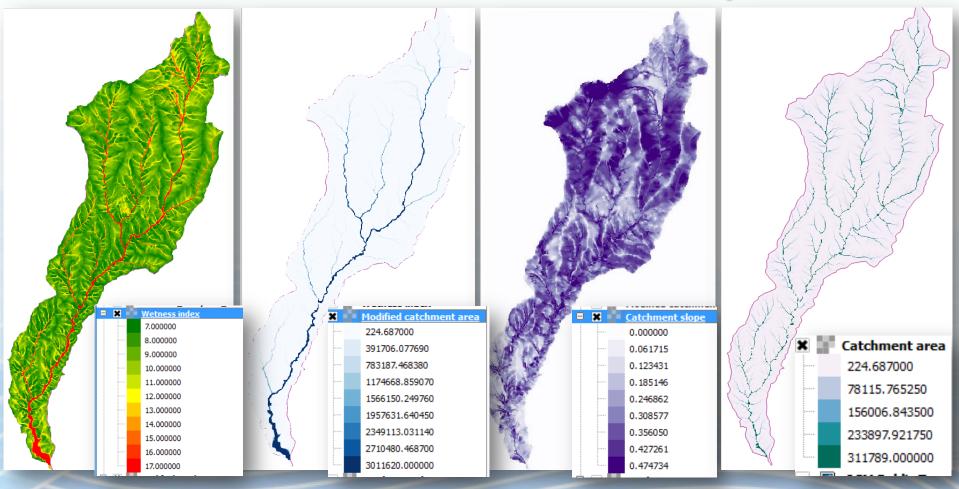
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SAGA Wetness Index - Outputs









Flow Width & Specific Catchment Area

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Flow Width & Specific Catchment Area

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Hydrology Science Bulletin 24(1)	, p.43-69				Flow Depth [interactive]
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Digital terrain modelling: a review	of hydrogical, geomorpholog	gical, and biologi	cal applications'		
Hydrological Processes, Vol.5, N	10.1				
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Name	Туре	Identifier	Description	Constraints	
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Differences due Common borders. Common solutions. to the **TWI vs SAGA WI** "Catchment Area" parameter SAGA (T)WI TWI A Layers BX Layers Hillshade_Analytical_S... Hillshade_Analytical_S... 🔺 40mart watershed 40mart watershed Wetness index Wetness index Modified catchme Modified catchment area Catchment slope Catchment slope Catchment area Catchment area OCM Public Transport OCM Public Transport StreamPowerIndex StreamPowerIndex SAGAWI_to_Shapefile SAGAWI_to_Shapefile 😑 🗶 📑 Topographic Wetness I.. Specific Catchment Are. 7.252190 3.000000 9.451718 4 000000 11.651245 5.000000 13.850773 6.000000 16.050300 ÷... Topographic Wetness I... 7.000000 3.000000 8.000000 4.000000 9.000000 10.000000 5.000000 11.000000 6.000000 Flow Width 7 000000 SAGA_TWI 8.000000 SPI 9.000000 SAGA_Junctions2 10.000000 Meteo_STATIONS 11.000000 tectonic_FAULTS 40mart_Geology Specific Catchment Are... 40mart_corine Flow Width 40mart_trigonom SAGA_TWI 40mart contours SPT 40mart DEMpoints SAGA_Junctions2 hydrol_net Meteo_STATIONS SoilEROSION RUSLE fina tectonic_FAULTS QGIS_DEM 40mart Geology SAGA_grid 40mart corine SAGA Grid 40mart_trigonom SAGA_grid_CLIP 40mart_contours SAGA Filled DEM 40mart_DEMpoints SAGA Flow Directions hydrol_net SAGA Watershed Ba... SoilEROSION_RUSLE_final SAGA Catchment area OGIS DEM SAGA Catchment sl... SAGA_grid Specific Catch -11 SAGA Strahler Order 2 SAGA Grid 10.599200 SAGA Topographic ... SAGA_grid_CLIP Ē × SAGA Modified catc.. SAGA Filled DEM 2710.517304 SAGA Wetness index SAGA Flow Directions 224.687000 SAGA Stream Power. 5410.435408 SAGA Watershed Ba... 391706.077690 Stream Network SAGA Catchment area 8110.353512 Terrain Ruggedness 由 SAGA Catchment sl... 783187.468380 Soil Erosion SAGA Strahler Order 2 10810.271616 1174668.859070 voronoi pr 13510.189720 1566150.249760 **Modified Catchment** Specific Catchment 16210.107824 1957631.640450 18702.339920 2349113.031140 20779.200000 Area Area 2710480.468700 Flow Width 3011620.000000







TWI vs SAGA WI



This is what has actually happen in Serres, eight years ago







We can also assess the <u>sediment</u> <u>production areas</u> in order to decide upon the optimal <u>location</u> of <u>sediment retention structures</u>







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🔷 Shapes - Point Clouds Viewer	Spatial Prediction of	f Soil Attrib	utes Using Te	rrain Analysis and Climate Regionalisation'			
📎 Shapes - Points	In Boehner J Mc	Clov K R	Strobl J SA	GA – Analysis and Modelling Applications', Goettinger Geographische Abhandlungen,	Vol 115 p 13-27		
Napes - Polygons		In: Definer, S., McColy, K.K., Sitob, S., SAGA – Analysis and Modelling Applications, Operatinger Geographische Abhandulingen, vol. 113, p. 13-21					
🔷 Shapes - Tools	Desmet & Govers (1996)					
🔖 Shapes - Transects			ally Calculati	ng the USLE LS Factor on Topographically Complex Landscape Units'			
Nimulation - Cellular Automata	Journal of Soil and						
Note: Simulation - Fire Spreading Analysis		Water Cons	ervation, 5 i(5)	.421.433			
Simulation - Hydrology	Kinnell, P.I.A. (200	5)-					
Simulation - Hydrology: IHACRES			ormining the l	JSLE-M Slope Length Factor for Grid Cells.'			
Simulation - Modelling the Human Impact	http://soil.scijournal		entining the c	1674			
TIN - Tools	mtp.//son.scijouma	is.org/cg//ct	menunun/03/3			SAGA G	
TIN - Visualisation	Moore, I.D., Grayso			001)-			
🔆 Table - Calculus				al, geomorphological, and biological applications'			
Table - Tools	Hydrological Proces			al, geomorphological, and biological applications			
Terrain Analysis - Channels	Hydrological Proces	sses, vol.5,	INO. 1				
Terrain Analysis - Compound Analyses	ME - harding MILL	0	(4070)				
Terrain Analysis - Hydrology	Wischmeier, W.H.,						
Catchment Area (Flow Tracing)				o conservation planning			
 Catchment Area (Mass-Flux Method) 	Agriculture Handbo	ok No. 537:	US Departme	nt of Agriculture, Washington DC.			
Catchment Area (Parallel)						=	
Catchment Area (Recursive)							
Cell Balance							
Source Data interactive]	Parameters				-		
 Edge Contamination 	Name	Type	Identifier	Description	Constrain	ts	
Elge Contamination Flow Depth [interactive]		1900	lacitation	Beschpion	Constraint		
Flow Depth [interactive]				Input			
Show Flow Sinuosity [interactive]							
Flow Sindosity [interactive] Flow Width and Specific Catchment A	Slope	Grid	SLOPE				
Sochrones Constant Speed Interaction		(input)					
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LS Factor	Catchment Area	Grid	AREA				
Lis Factor		(input)					
	Output						
				Output	2		
		Grid	LS				
SAGA Wetness Index	LS Factor						
	LS Factor						
	LS Factor	(output)					
Slope Length Stream Power Index Topographic Wetness Index (TWI)	LS Factor			Options			
 Slope Length Stream Power Index Topographic Wetness Index (TWI) Upslope Area 		(output)		,			
Slope Length Stream Power Index Topographic Wetness Index (TWI) Upslope Area Upslope Area [interactive]	Area to Length		CONV	Derivation of slope lengths from catchment areas. These are rough approximations!	Available Choices:		
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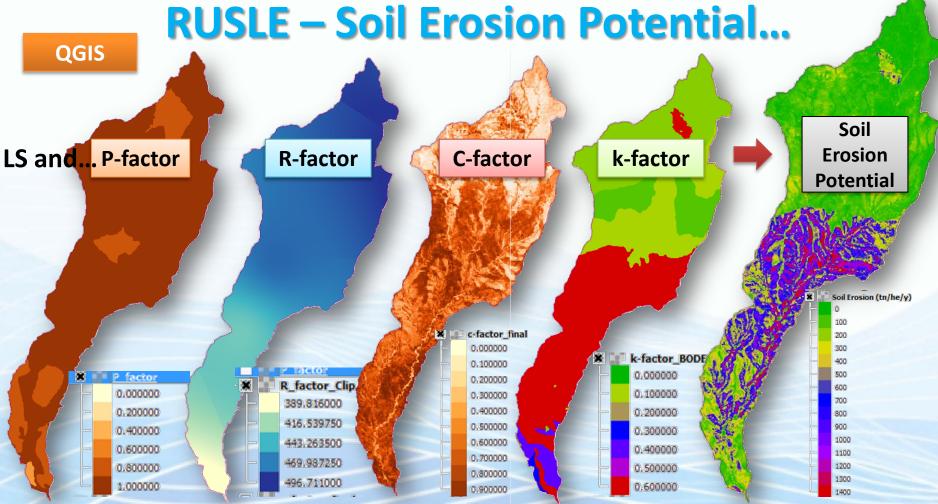
RUSLE – LS factor

⊕ Table - Tools ⊕ Terrain Analysis - Channels	🏑 Ls factor	
Terrain Analysis - Hydrology	13	
🔤 🚫 Burn stream network in	Parameters Log Help	
Catchment area (flow t		
🗠 🚫 Catchment area (mass	Slope	
Catchment area (parall		
Catchment area (recur	SAGA_Slope [EPSG:2100]	
Cell balance	Catchment Area	
Edge contamination		
	Specific Catchment Area (SCA) [EPSG:2100]	
Fill sinks (wang & liu)	Area to Length Conversion	
Fill sinks xxl (wang & liu)	[0] no conversion (areas already given as specific catchment area)	
Flat detection		
Flow path length	Method (LS)	
Flow width and specific	[0] Moore et al. 1991	
Lake flood	Rill/Interrill Erosivity	
Ls factor		
Saga wetness index	0.000000	
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Upslope Area	LS Factor	1,000000
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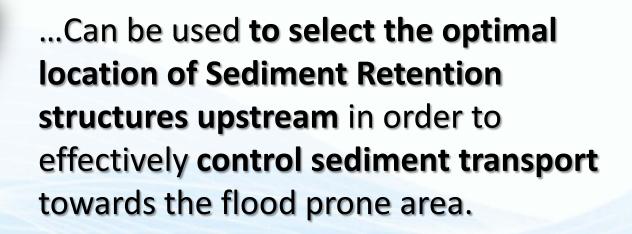
... to support decisions regarding RETENTION measures







RUSLE – Soil Erosion Potential...



Soil Erosion Potential

Soil Erosion (tn/he/y)







Flood Hazard... on Regional Scales and on Local scales Regional Scale Tekirdag area-Turkey raphic Wetness Index (TWI) Legend 9.0 area P 10.0 11.0 Local Scale Taita river Dobrogea







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2007-2013

Common borders. Common solutions.

A Scientific Network for La **Hazard Prevention** Se Project SciNet NatHaz revention knowledgments: D **Cantially** funded the ext of the Black Sea Basin Joint Operational Programme







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