



Linked Open Data in Agriculture

MACS-G20 Workshop

Berlin, September 27-28, 2017



VITIS

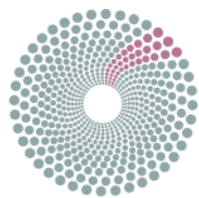
A Linked Data toolkit for a data-centric
grape economy

Antonis Koukourikos (Agroknow)

“Research is a Data-driven process”

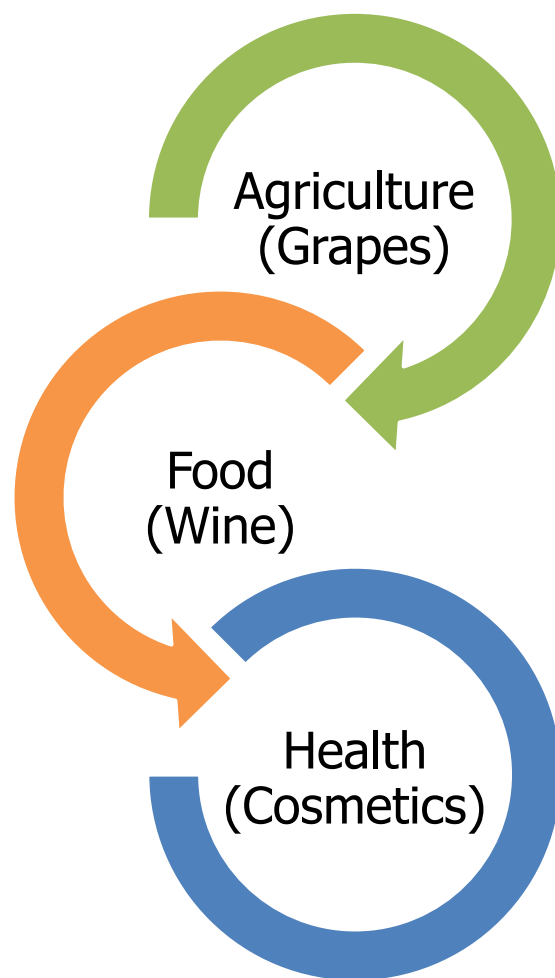
“Huge volumes of data may be compelling at first glance, but without an interpretive structure they are meaningless”

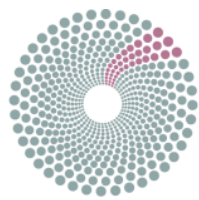
- Tom Boellstorff, *Ethnography and Virtual Worlds: A Handbook of Method*



Grapevine-powered Industry

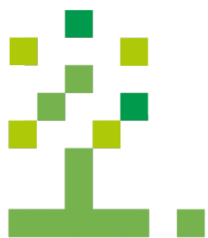
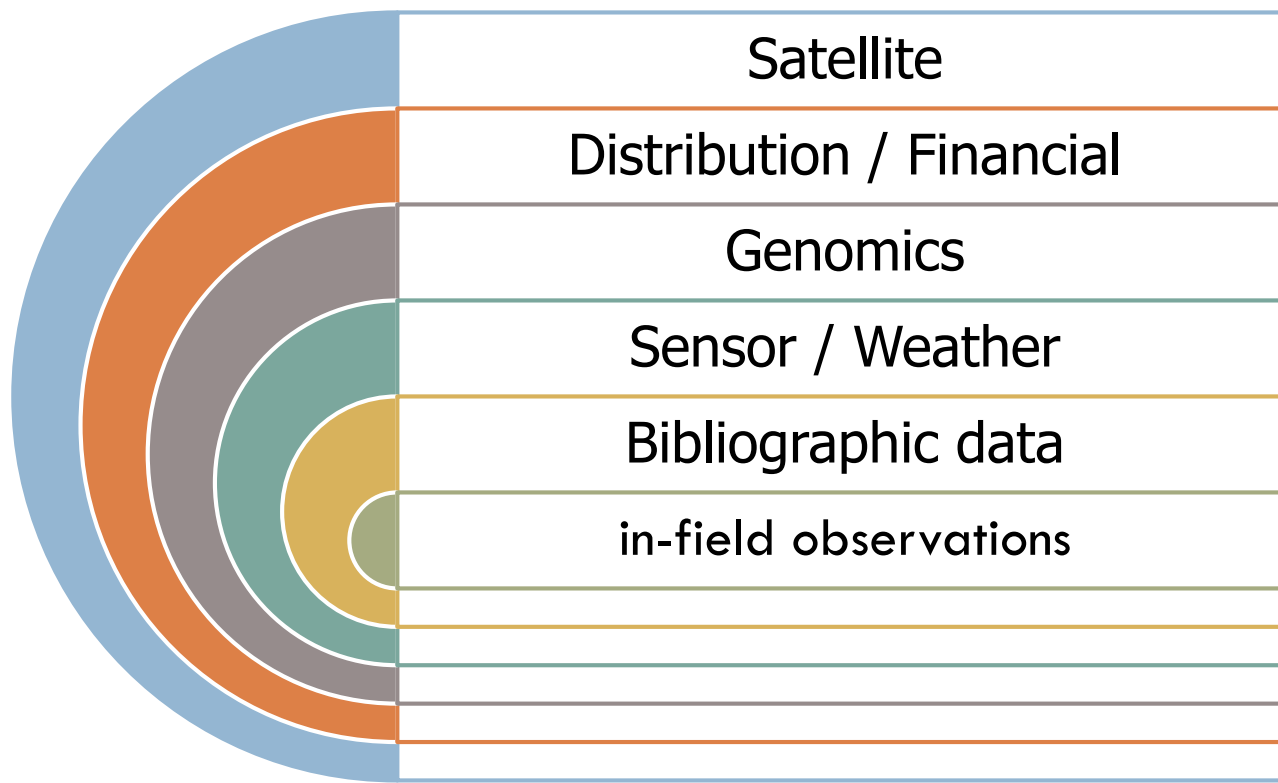
addressing cross-sector problems

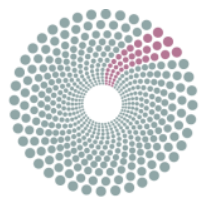




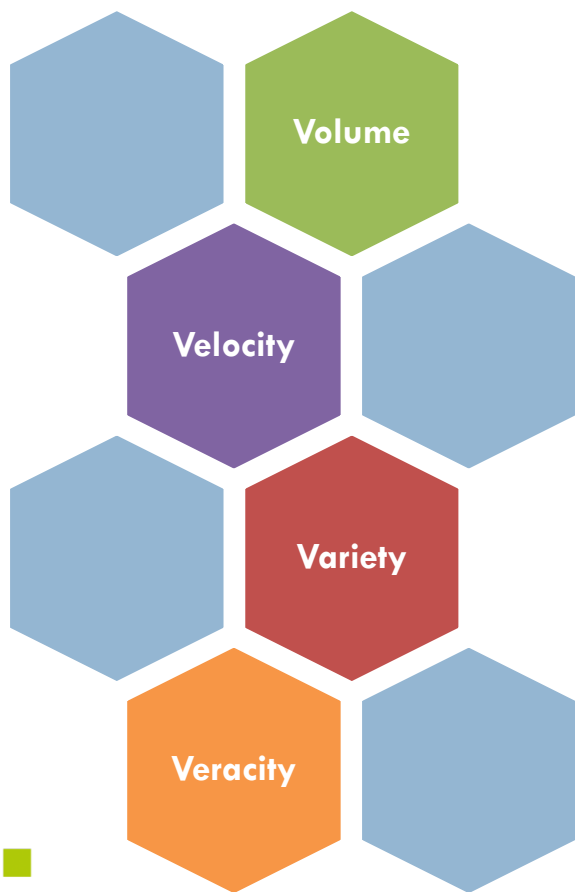
Data Spectrum

extremely heterogeneous (& Big)



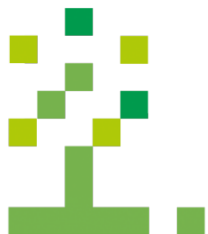


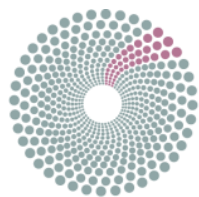
Data Challenges in the Big Data era



“ **But**, all the volumes of fast-moving data of different variety and veracity have to be turned into value! This is why value is the one V of big data that matters the most ”

Why only one of the 5 Vs of big data really matters
Bernard Marr, IBM Big Data & Analytics Hub





Sector-specific Research

→ turn Data into Knowledge / Value

Identification of grapevine varieties

- Ampelography
- Molecular methods
- Improved and healthy vine propagation material

Viticulture and climate change

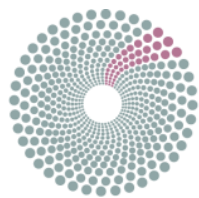
- Impact on growth and quality
- Impact on the developmental physiology and ecophysiology
- Adaptation of varieties and rootstocks

Full profile of grapevine varieties

- Phenotypic
- Genetic
- Phenolic



**... affecting all sectors of the
Grapevine-powered data-value chain**



Viticulture & Winemaking

a cross-border activity

Italy (Piedmont)



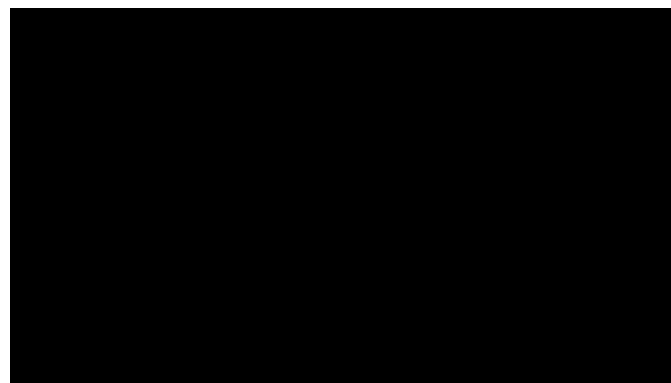
France (Bordeaux)



China (Ningxia)

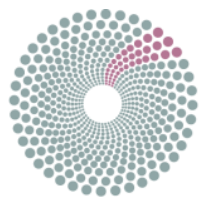


Greece



... and many more





What we have achieved so far

vitis.agroknow.com

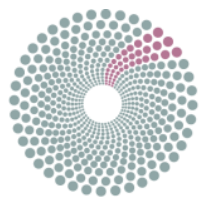
The screenshot shows the Vitis website with a dark blue header and a light blue main content area. The header includes the Vitis logo and a navigation menu with links: HOME, VARIETIES, IDENTIFICATION, NETWORK, APP, DATA API, ABOUT, and LOGIN. In the top right corner, there are flags for the United Kingdom, Greece, and France.

The main content area features a large section titled "Viticulture & Winemaking" with the subtitle "a flavourful view to a connected world from Greece". Below this is a video player showing a scene of wine being poured into a glass, with a "Discover Greece" logo in the top left corner. Below the video player is a horizontal timeline with three markers: Canada, China, and Greece. The Greece marker is highlighted with an orange dot.

To the right of the video player are four interactive cards:

- LEARN ABOUT VITIS GRAPE VARIETIES**: Vitis currently incorporates information on the characteristics of the core 68 varieties cultivated in Greece.
- IDENTIFY YOUR VARIETY**: Varietal identification is essential to any grape growing operation. Ampelography and DNA Fingerprinting are valuable tools.
- EXPLORE VITIS NETWORK OF VITICULTURE RESEARCH**: The network is generated from scientific publications pertaining to viticulture available in the AGRIS, PubMed, and CORE registries.
- REGISTER**: By registering to VITIS you gain free access to VITIS mobile apps for in-field data collection.





VITIS Intuitive Visualization

VITIS HOME VARIETIES IDENTIFICATION NETWORK APP DATA API ABOUT LOGIN

GRAPEVINE VARIETIES

— i —

"The Juice of the Grapes is the Liquid Quintessence of Concentrated Sunbeams"
- Thomas Love Peacock

AGIORGITIKO
Blue-Black (Wine)
Cultivated in:

AIDANI ASPRO
White (Wine)
Cultivated in:

ASSYRTIKO
White (Wine)
Cultivated in:

ATHIRI
White (Wine)
Cultivated in:

Penteskoufi White Dry Wine

Karagianni Family

From grapes of the Grapes Vineyard. The average annual temperature in this vineyard is 64.8°F (18.2°C). The warmest month, on average, is July with an average temperature of 81.0°F (27.2°C). The coolest month on average is January with an average temperature of 50.9°F (10.5°C). The average annual precipitation in this vineyard is 35.1" (895.9 mm). The wettest month is February with an average of 2.4" (61 mm) of precipitation. The driest month is July with an average of 0.2" (5.1 mm) of precipitation. In terms of liquid precipitation, there are an average of 73.2 days of rain, with the most rain occurring in February with 10.9 days of rain, and the least rain occurring in August with 1.0 days of rain.

FLAVOR PROFILE

Roditis (60%) - Savatiano (40%)
2016 Cultivation

Bloom

08 May 2016

Waxing Crescent
Illumination: 48%
Moon Age: 1.56 Days
Moon Angle: 0.54
Sun Angle: 0.54

by AUA

of information on the core 68 grape varieties cultivated in Greece

Cabernet Sauvignon

Phenological Stages in Greece

Bud burst Bloom Veraison

VINEYARDS WITH CABERNET SAUVIGNON IN GREECE

Classification Schemes

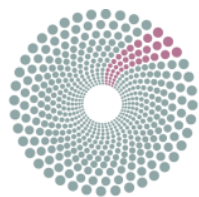
VITIS - 577
OIV - 577
VIVC - 1929

Ampelographic Description

VITIS Grape

by AUA





VITIS Large-scale Linguistic Pipeline

full-text mining over PDF files ingested
from AGRIS, PubMed and CORE

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QUANTITATIVE DETERMINATION OF OCHRATOXIN A IN WINE

Valon Y. Durguti¹, Petya V. Stefanova², Angel I. Angelov³
¹ College of Medical Sciences, Tuzla - Razanovca, Pristina, Kosovo
² Department of Biotechnology - University of Food Technologies, Plovdiv, Bulgaria

Abstract

Through the use of the analytical method known as HPLC-FD and previously used the method for extraction of ochratoxin A by immunoaffinity columns, we have analyzed 25 samples of 2013 newly fermented wine, which have just finished alcoholic fermentation process. 11 of which have been analyzed from different regions of Italy and 14 other samples from two regions of Kosovo. From the total number of samples, 24 samples were red wine and only one was white wine. The results of all analyzed samples have been below the limit allowed by the EU for ochratoxin A i.e. 2 µg/L.

Key words: wine, ochratoxin A, HPLC-FD, immunoaffinity column, mycotoxins

1. INTRODUCTION

Ochratoxin A, N-[6R-(5-chloro-8-hydroxy-3-methyl-1-oxo-7-isochroman-2-yl) carbonyl]-L-phenylalanine (Fig. 1) is a mycotoxin produced by certain species of *Aspergillus* and *Penicillium* filamentous fungi. The *Penicillium* species that is associated with ochratoxin A production, *Penicillium verrucosum*, is a common storage species and the source of ochratoxin A in crops in the cool temperate regions such as Canada, eastern and north western Europe and parts of South America. It grows only at temperatures below 20°C and at a lower water activity. *Penicillium* species may produce ochratoxin A at temperatures as low as 5°C (Risk Assessment Studies, <http://www.ch.gov.uk>).

Aspergillus species appears to be limited to conditions of high humidity and temperature prevailing in the tropical and subtropical climates and is the source of contamination for coffee and cocoa beans, spices, dried vine fruit, grape juice and wine. *Aspergillus ochraceus* is the best known species of ochratoxin-producing *Aspergillus*. It grows at moderate temperatures and at a high water activity and is a significant source of ochratoxin A in cereals. It infects coffee beans usually during sun-drying causing contamination in green coffee (Risk Assessment Studies, <http://www.ch.gov.uk>). *Aspergillus carbonarius* is highly resistant to sunlight and survives sun-drying because of its black spores and therefore grows at high temperatures. It is associated with rotting fruit and is the source of ochratoxin A in grapes, dried vine fruit, and wine and is also another source of ochratoxin A in coffee (Risk Assessment Studies, <http://www.ch.gov.uk>).

Aspergillus niger, is another major source of ochratoxin A production in infected coffee beans and dried vine fruit. The mycotoxin has been detected in various food stuffs such as dried fruit, coffee, maize, sorghum, wheat, pulses and wine (Moret and Frutkin, 1992; Serna and Sander, 1999).

Ochratoxin A is a mycotoxin which is soluble in organic solvents, in aqueous solution of sodium bicarbonate and slightly soluble in water. The compound of OTA is in high stability. It is shown that it has a pronounced resistance to acidity and high temperatures. Thus, when foods are contaminated, it is very difficult to remove completely. At normal cooking showed that OTA was only partially degraded (Muller, 1982). Moreover, this molecule can withstand steam sterilization three hours with high pressure 121 °C, and even at 250 °C its destruction is not complete.

Mycotoxins can cause serious health problems in animals and humans known as mycotoxicosis (Muller, 1983). Mycotoxins can be classified as hepatocarcinogenic, nephrotoxic, immunotoxic, teratogenic, mutagenic, carcinogenic, cytotoxic, and so forth. Some mycotoxins are specifically indicated or strongly suspected as the cause of severe human and animal diseases, such as Reye's disease, caused by aflatoxin B1 (AFB1), renal leukoencephalomalacia and porcine pulmonary edema, caused by fumonisin B1 (FB1), human disseminated toxic adenoma, caused by T2 toxin, and Balkan endemic nephropathy, caused by ochratoxin A (Goswami et al., 2013). OTA is regularly a risk factor for Balkan endemic nephropathy (BEN). BEN is a chronic tubulointerstitial kidney disease that occurs in some areas of Bosnia and Herzegovina, Bulgaria, Croatia, Romania, Serbia, and Montenegro (Vardanova et al., 2010). Based on extensive research across the world has shown that the OTA is present not only in European countries but also in other continents of the globe. Scientific research has shown the

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histopathological changes to the kidneys and liver of rats (Aydin et al., 2013). OTA has been observed to be hepatocarcinogenic in a number of animal models including rat, mouse, hamster, and duck, with reduced birth weight and craniofacial abnormalities being the most commonly observed malformations (O'Brien et al., 2005). OTA also has been found to have genotoxic and immunotoxic effect in *Wistar* male rats (Ahmed et al., 2004). OTA exposure has been associated with increased levels of oxidative DNA, lipid, and protein damage. Several various biological processes known to be mobilized under oxidative stress were shown to be altered by OTA. These effects have been observed in both *in vitro* and *in vivo* test systems. *In vitro*, active doses were often within doses documented to induce renal tumors in rats (Doria - Xilias et al., 2011). International Agency for Cancer Research classified OTA as potential carcinogenic substance for man (group 2B). Zimmert and Dick (1985) were the first ones to report the existence of OTA in wine. The European Union Regulation (EC 1831/2005) limit for OTA in wine is 2 µg/L.



[2014]

International Scientific Publications: Agriculture and Food

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Through the use of the analytical method known as HPLC-FD and previously used the method for extraction of ochratoxin A by immunoaffinity columns, we have analyzed 25 samples of 2013 newly fermented wine, which have just finished alcoholic fermentation process, 11 of which have been analyzed from different regions of Italy and 14 other samples from two regions of Kosovo. From the total number of samples, 24 samples were red wine and only one was white wine. The results of all analyzed samples have been below the limit allowed by the EU for ochratoxin A i.e. 2 ng/ml.

Keywords: wine, ochratoxin A, HPLC-FD, immunoaffinity column, mycotoxin

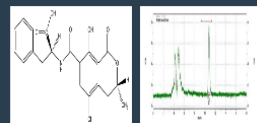
[View Document](#)
[View Catalog](#)

VITIS Varieties

Sauvignon
Merlot Ugni Blanc
Refosco Pinot Noir Sangiovese
Cabernet Sauvignon
Cabernet Franc

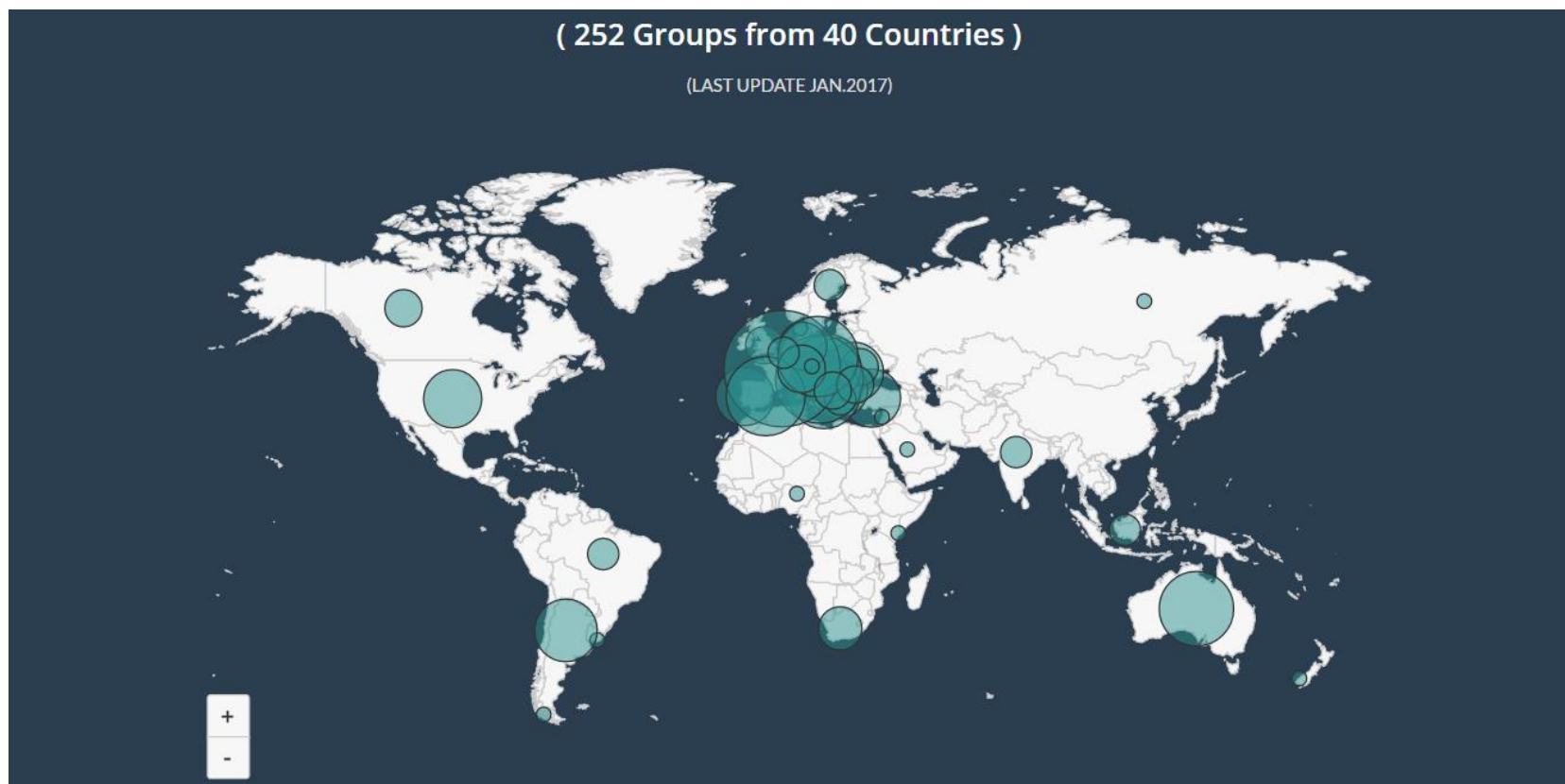
AgroVoc

Alternaria
extraction Aspergillus
Europe species risk Veneto EU grapes
volume Italy coffee crops
toxins water HPLC Niger toxicity
birth agriculture
Calabria leukoencephalomalacia





VITIS Atlas of Viticulture Research



relevant to VITIS grape varieties

[extracted from indexed publications]





VITIS

Linking of Heterogeneous Data (1/2)

Cabernet Sauvignon

Ampelographic Description (OIV Primary Descriptors)

by Agricultural University of Athens

Young shoot

001- opening of the shoot tip
5 (fully open)
004- density of prostrate hairs on the shoot tip
5 (medium) - 7 (high)

Shoot

016- number of consecutive tendrils
1 (2 or less)

Young leaf

051- color of upper side of blade (4th leaf)

Mature leaf

067- shape of blade
4 (circular)
068- number of lobes
3 (five)
070- area of anthodermis on upper side of blade
1 (absent)
076- shape of teeth
3 (both sides convex)
079- degree of open sinus
7 (overlapped)
081-2- petiole sinus base limited by veins

Genetic profile

Microsatellites	VVS2		VMD5		VrZAG62		VrZAG79		VMD7		VMD25		VMD27		VMD28		VMD32	
Source	A1	A2	A1	A2	A1	A2	A1	A2	A1	A2	A1	A2	A1	A2	A1	A2	A1	A2
VIVC	139	151	234	242	188	194	247	247	239	239	239	249	176	190	234	236	240	240
IVD	139	151	231	239	188	194	247	247	239	239	240	250	175	189	237	239	241	241
PI@nt Grape	137	149	229	238	188	194	248	248	239	239	238	248	172	186	233	235	239	239
SVMQ	139	151	232	240	189	195	247	247	239	239	-	-	175	189	-	-	-	-

Ampelographic, Genetic and Climate

Alikambos Vineyard (35.349139,24.203232)

Dourakis Winery

Vineyard Size: 1.9 ha

Climate Info (Mediterranean Climate)



Under the Koppen-Geiger Climate Classification, "dry-summer subtropical" climates are often referred to as "Mediterranean". This climate zone has an average temperature above 10°C (50°F) in the warmest months, and an average temperature between 18 to -3°C (64 to 27°F) in the coldest months. Summers tend to be dry with less than one-third of precipitation of that of the wettest winter month, and with less than 30 mm (1.18") of precipitation in a summer month. Many of the regions with Mediterranean climates have relatively mild winters and very warm summers.

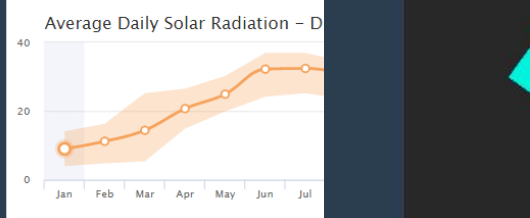
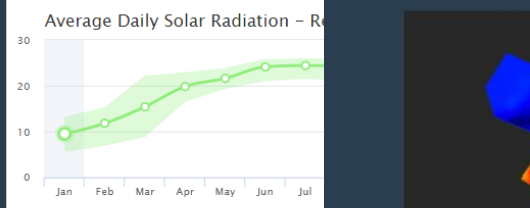
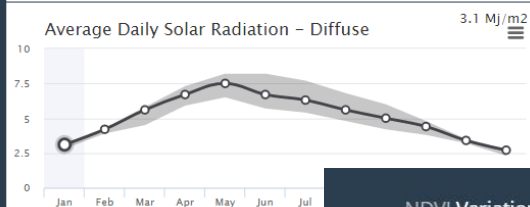
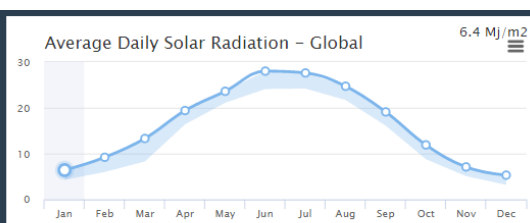
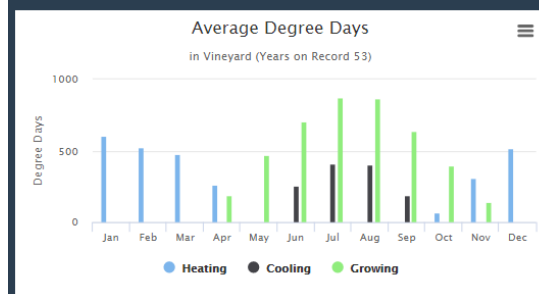
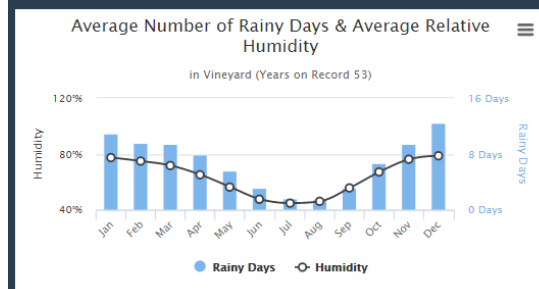
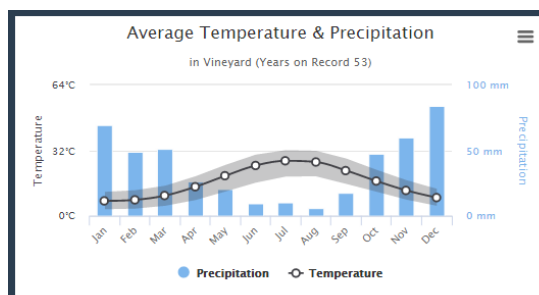
The average annual temperature in this vineyard is 64.8°F (18.2°C). The warmest month, on average, is July with an average temperature of 81.0°F (27.2°C). The coolest month on average is January with an average temperature of 50.4°F (10.2°C).

The average annual precipitation in this vineyard is 16.1" (408.9 mm). The wettest month is February with an average of 2.4" (61 mm) of precipitation. The driest month is July with an average of 0.2" (5.1 mm) of precipitation. In terms of liquid precipitation, there are an average of 73.2 days of rain, with the most rain occurring in February with 10.9 days of rain, and the least rain occurring in August with 1.0 days of rain.

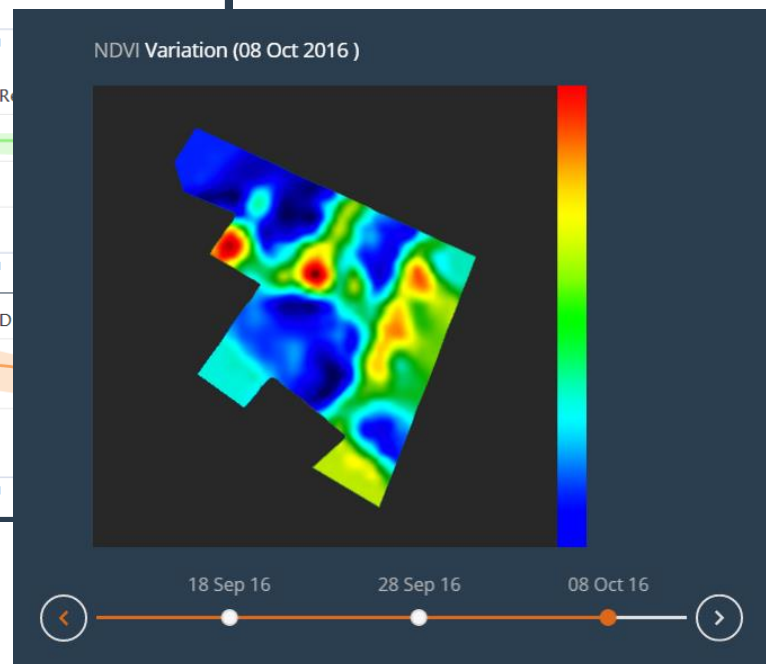


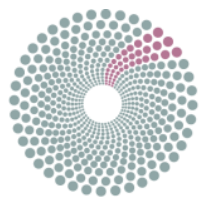


VITIS Linking of Heterogeneous Data (2/2)



Sensor / Weather and
Satellite Imaging





VITIS Integrated tools for end-users (1/2)

Forecast No precipitation throughout the week, with temperatures rising to 20°C on Saturday.

Sunday, Feb 19th

Mostly cloudy throughout the day.

17° 7° ☁ 12% ☁ 63%
☀ 7:11 ☀ 6:09

Monday, Feb 20th

Mostly cloudy until afternoon.

19° 9° ☁ 5% ☁ 56%
☀ 7:10 ☀ 6:10

Tuesday, Feb 21st

Clear throughout the day.

17° 6° ☀ 3% ☀ 3%
☀ 7:09 ☀ 6:11

Wednesday, Feb 22nd

Clear throughout the day.

☀ 18° 6° ☀ 0% ☀ 0%
☀ 7:07 ☀ 6:12

Thursday, Feb 23rd

Partly cloudy in the afternoon.

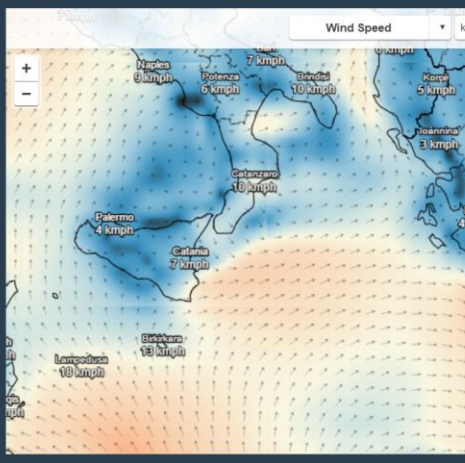
☀ 18° 6° ☁ 1% ☁ 15%
☀ 7:06 ☀ 6:13

Friday, Feb 24th


Clear throughout the day.

☀ 18° 7° ☀ 0% ☀ 1%
☀ 7:05 ☀ 6:14

Weather forecast and
mobile app for in-field
data collection





VITIS Companion



VITIS Companion
Agroknow
PEGI 3

INSTALL

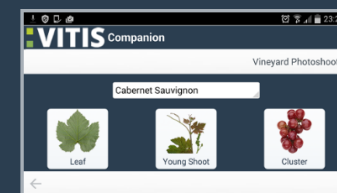
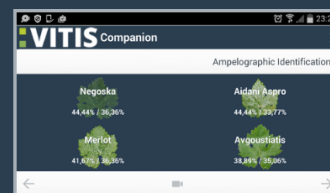
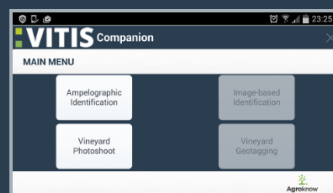
 Education
 Similar

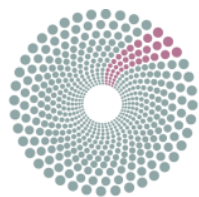
VITIS Companion is an application enabling easy on-the-vineyard data collection. VITIS Companion provides the following services:

- On-the-vineyard Ampelographic Identification
- Vineyard Photoshoot (Leaf, Young Shoot, and Cluster)
- Vineyard Geotagging

Available @ Google Play Store

* To use all VITIS Companion functionalities you need to be a REGISTERED VITIS USER







VITIS


Integrated tools for end-users (2/2)


Identify Your Variety

 Ampelographic

 Genetic


Microsatellites	VWS2	VVMD5	VrZAG62	VrZAG79	VVMD7
A1	133	242	188	251	243
A2	135	242	202	257	249

 Identify Variety




ASSYRTIKO
White (Wine)

Match: 100.0%
Confidence: 88.9%



Ampelographic and
Genetic identification

DATA API


 VITIS data are modeled following the VITIS Ontology and are accessible via a single SPARQL endpoint. You can use the following form to send queries directly to the VITIS endpoint, or use the VITIS Triple Store REST API to programmatically access the repository.

Select a Question or make your own

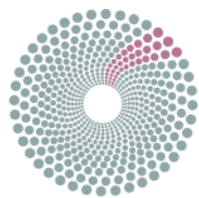
Select a question

SPARQL Query

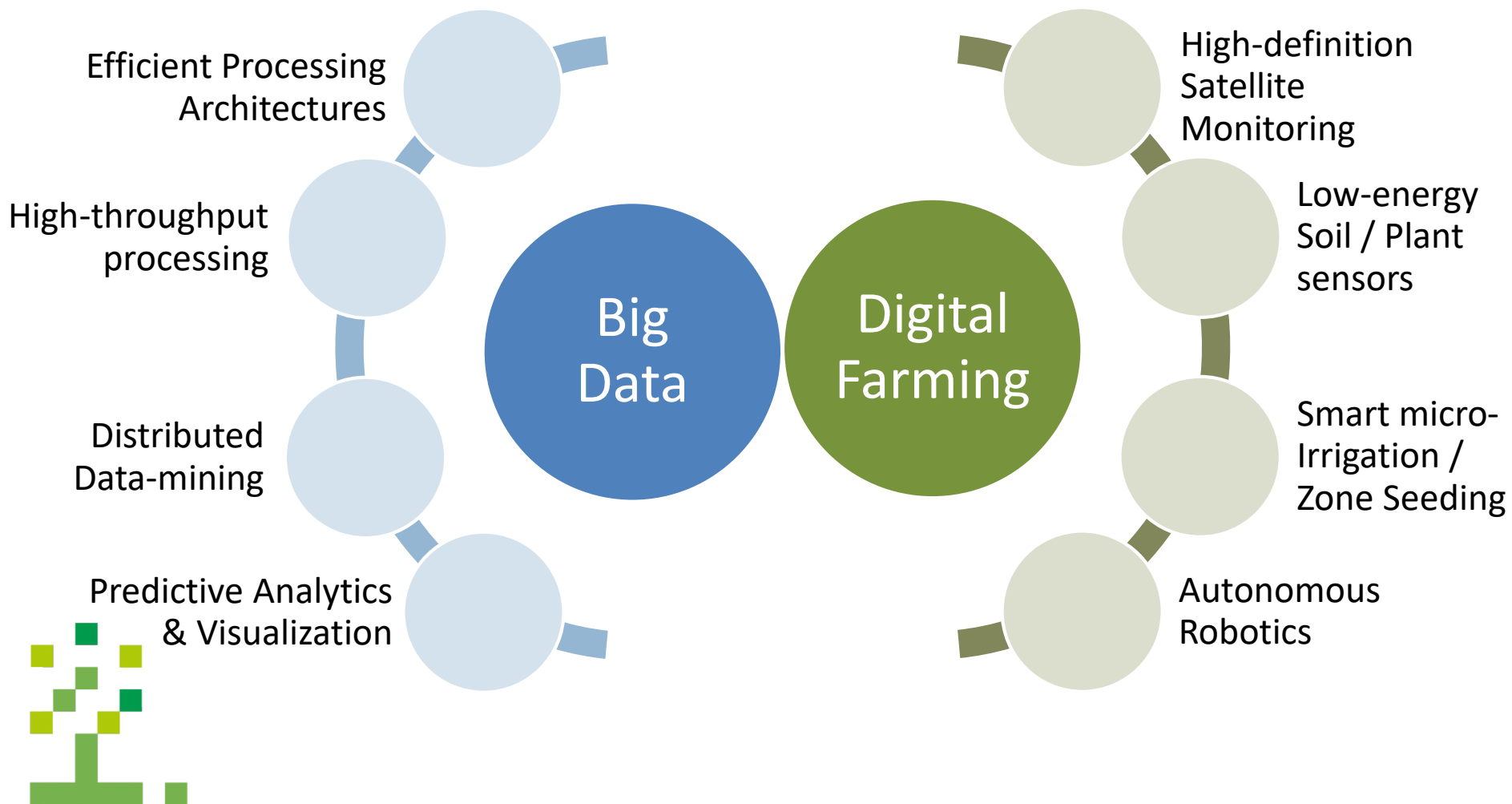
Result

 Query

Data access via a single
SPARQL endpoint



Technological Challenges of a data/services/apps ecosystem





What next?

5-star deployment scheme for Open Data as proposed by sir Tim Berners-Lee



Achieving FAIRness at the metadata level is only the first step towards the grander picture of deriving bigger, actionable knowledge and value from shared research data!



By using data mining for discovering the meaning (semantics) of data...



...and expressing them as semantic web resources...



...reusing established specifications...



You can be linked to the world!



THANK YOU

... and do not forget to visit **VITIS** at
vitis.agroknow.com