

"Integrated inter-sector framework to increase the thermal resilience of European workers in the context of global warming"



**HEAT
SHIELD**



This project has received funding from the European Union's Horizon 2020, Grant Agreement No 668786

<https://www.heat-shield.eu/>

Progetto Heat Shield (Horizon 2020): casi studio per la valutazione degli effetti del caldo sui lavoratori impiegati nel settore agricolo nella provincia di Firenze

Home Projects



Agriculture
VIEW SUMMARY



Marco Morabito – IBIMET-CNR



Simone Orlandini – UNIFI-CIBIC



Alessandro Messeri – UNIFI-CIBIC



About HEAT-SHIELD

HOT NEWS

"Integrated inter-sector framework to increase the thermal resilience of European workers in the context of global warming"



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WP1

WP2

WP3

WP5

WP1

- raccolta bibliografica dei principali **indici di stress termico**
- creazione di una **piattaforma prototipale** per l'invio di allerte in caso di condizioni di stress da caldo per i lavoratori

WP2

supporto per la progettazione e successiva realizzazione di **mappe di vulnerabilità da caldo**

WP3

Valutazione dei rischi e ottimizzazione delle soluzioni per mitigare lo stress da caldo dei lavoratori che operano nel **settore agricolo e delle costruzioni (casi studio)**

WP5

Sviluppo di una **piattaforma web** a supporto dell'industria e della società per prevedere condizioni di stress da caldo per i lavoratori e fornire linee guida comportamentali

MDPI Journals A-Z Information & Guidelines About Editorial Process

 Title / Keyword Journal
Author Section
Article Type Special Issue Advanced

Volume 8, Issue 7

Article Versions

- Abstract
- Full-Text PDF (1679 KB)
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Atmosphere 2017, 8(7), 115; doi:10.3390/atmos8070115

Increasing Heatwave Hazards in the Southeastern European Union Capitals

Marco Morabito ^{1,2,*}, Alfonso Crisci ¹, Alessandro Messeri ², Gianni Messeri ^{1,3}, Giulio Betti ³, Simone Orlandini ^{2,4}, Antonio Raschi ¹ and Giampiero Maracchi ⁵

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(This article belongs to the Special Issue Temperature Extremes and Heat/Cold Waves)

| [1679 KB, uploaded 30 June 2017] |

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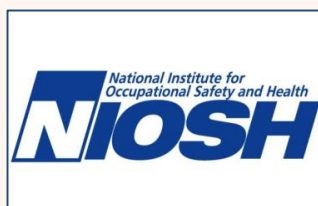
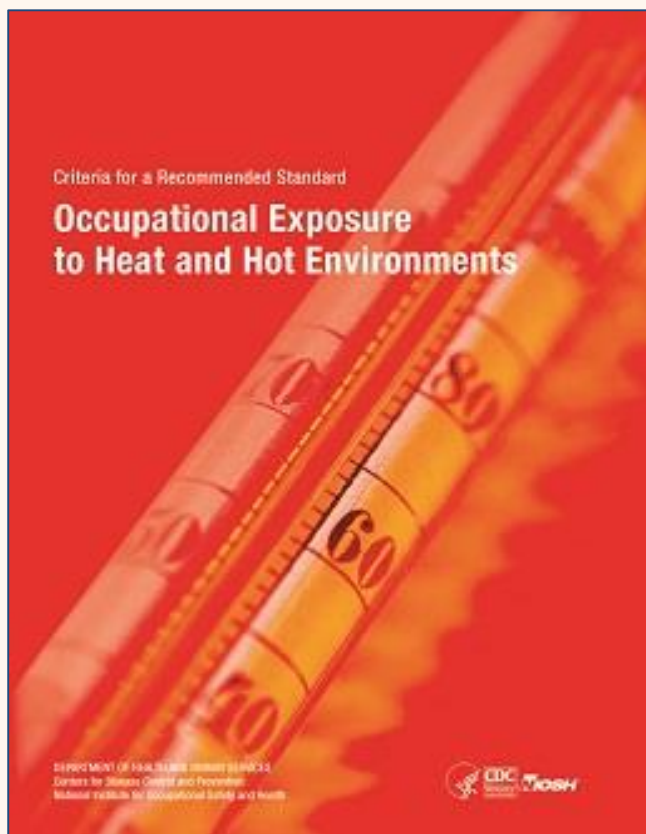
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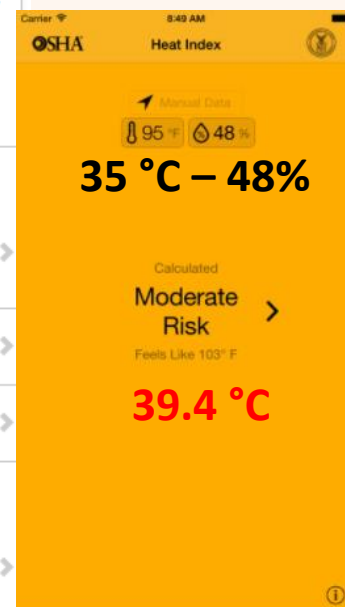
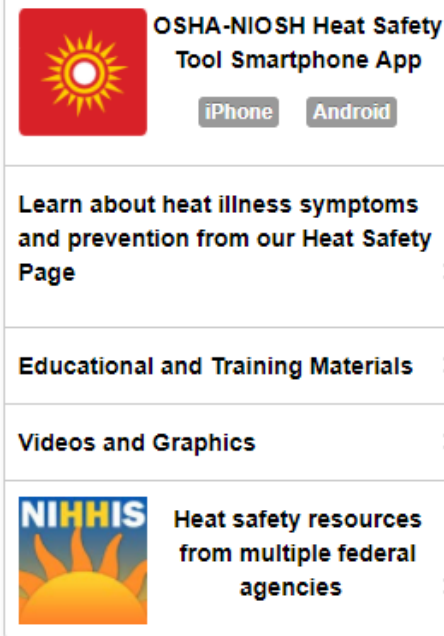
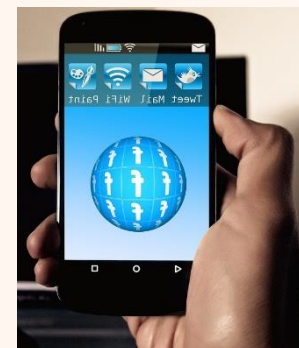
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<https://www.heat-shield.eu/>

Revisione dei principali indici biometeorologici impiegati a livello internazionale in sistemi di allerta da caldo specifici per i lavoratori



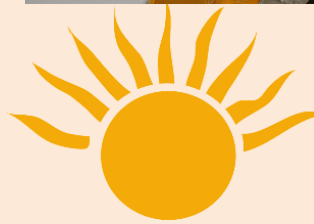
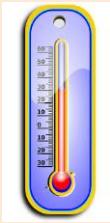
The work can't get done without them.



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WBGT ombra = 0.7 twn + 0.3 tg in °C

WBGT sole = 0.7 twn + 0.2 tg + 0.1 tdb in °C

twn = temperatura del termometro a bulbo umido naturalmente ventilato

tg = temperatura del globotermometro

tdb = temperatura di bulbo secco

Correzione di WBGT in base all'abbigliamento indossato

Clothing Type	WBGT Correction
Work clothes (long sleeve and pants)	0
Cloth (woven material) coveralls	0
Double layer woven clothing	3
SMS polypropylene coveralls	0.5
Polyolefin overalls	1
Limited use vapour-barrier overalls	11

Valori WBGT infunzione dei ritmi di lavoro

Sforzo lavorativo	Acclimatato				Non acclimatato			
	leggero	moderato	pesante	molto pesante	leggero	moderato	pesante	molto pesante
100% lavoro	29,5	27,5	26,0		27,5	25,0	22,5	
75% lavoro; 25% riposo	30,5	28,5	27,5		29,0	26,5	24,5	
50% lavoro; 50% riposo	31,5	29,5	28,5	27,5	30,0	28,0	26,5	25,0



Conference of Governmental Industrial Hygienists (ACGIH) 1985, Employment and Social Development Canada (ESDC).

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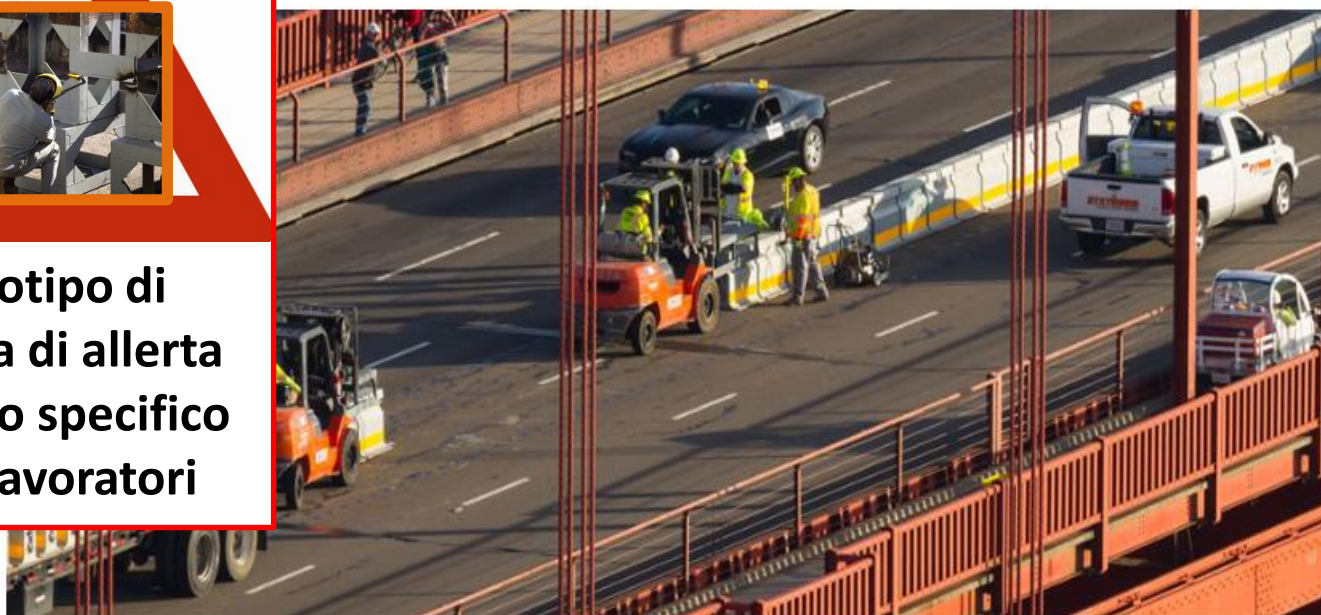
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Call identifier: H2020-PHC-2015
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[PROJECT](#) [FORECAST](#) [ENGLISH](#) [ITALIANO](#)



**Prototipo di
sistema di allerta
da caldo specifico
per i lavoratori**



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Soglie di rischio

Soglie di rischio attualmente impiegate

Acclimatized Work			
Light Work			
Thresholds (°C)	Risk	Work in 1 hour (minutes)	Water intake (liter)
<30	no risk	no limits	
from 30 to 31	low risk	60	
from 31 to 32	medium risk	45	
from 32 to 33	high risk	30	
>33	very high risk	15	
moderate Work			
Thresholds (°C)	Risk	Work in 1 hour (minutes)	Water intake (liter)
<28	no risk	no limits	
from 28 to 29	low risk	60	1
from 29 to 30	medium risk	45	1
from 30 to 32	high risk	30	1
>32	very high risk	15	>1
heavy Work			
Thresholds (°C)	Risk	Work in 1 hour (minutes)	Water intake (liter)
<27	low risk	50	>1
from 27 to 29	medium risk	45	>1
from 29 to 31	high risk	30	>1
>31	very high risk	15	>1
very heavy Work			
Thresholds (°C)	Risk	Work in 1 hour (minutes)	Water intake (liter)
<28	medium risk	25	>1
from 28 to 30	high risk	30	>1
>30	very high risk	15	>1

Threshold Limit Values for Physical Agents (TLV®-PA)

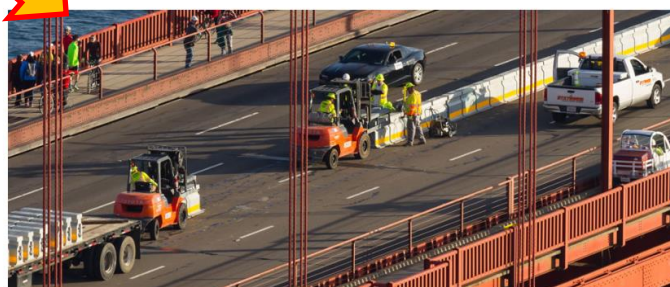
Thoma
Cham
Universit



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PROJECT FORECAST ENGLISH ITALIANO



Heat Shield

Casi studio



ACGIH 2011. Heat stress and strain: documentation of TLVs and BELs. Cincinnati. OH: American Conference of Governmental Industrial Hygienists

Ricalibrazione delle soglie

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Aziende



Azienda agricola il Palagio
Figline Valdarno (Fi)



Azienda agricola Oscar Tintori
Pescia (PT)



Cantiere della tramvia
Firenze

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Monitoraggio ambientale in continuo



- **n.1 stazione meteorologica**

- Temperatura dell'aria
- Umidità dell'aria
- Pressione atmosferica
- Radiazione solare
- Velocità e direzione del vento
- **Temperatura media radiante**



- **n.4 termoisolatori**

- Temperatura dell'aria
- Umidità dell'aria



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Monitoraggio fisiologico e comportamentale



Periodo di test
Maggio-Settembre



Giorni di test



Rischio da caldo almeno moderato

n.3



n.3

Nessun rischio

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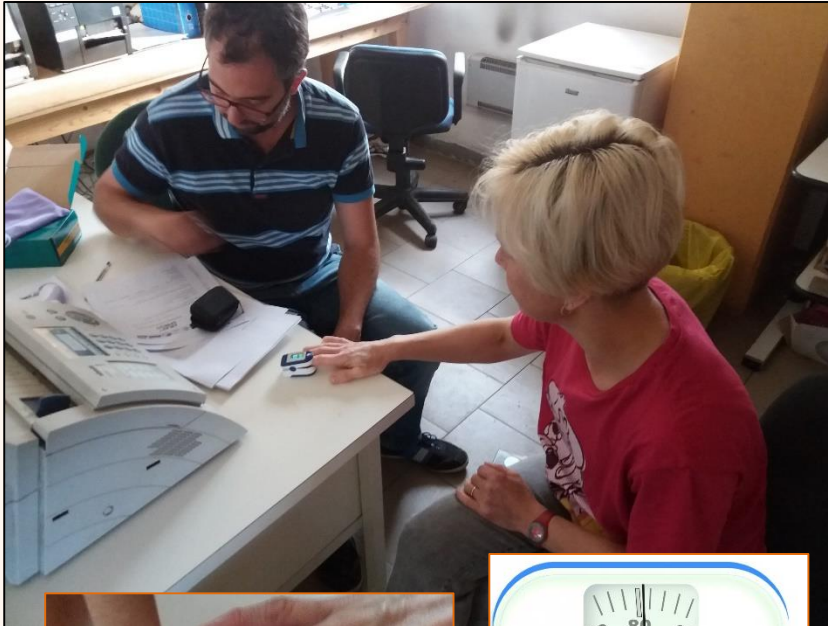


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Monitoraggio fisiologico per ciascun soggetto



- **Frequenza cardiaca e saturazione d'ossigeno**
 - Determinate attraverso pulsossimetro
- **Peso corporeo**
 - Determinato con bilancia pesapersona
- **Temperatura corporea**
 - Determinata con termometro ad infrarossi



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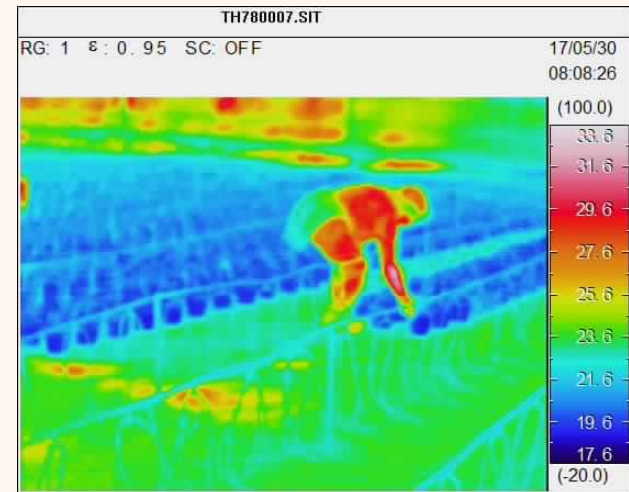
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Monitoraggio fisiologico per ciascun soggetto

- **Foto**
 - Valutazione dell'abbigliamento indossato
- **Immagini termografiche**
 - Valutazione del calore istantaneo emesso per irraggiamento dalle superfici e dai soggetti



**Giacche
ventilate**



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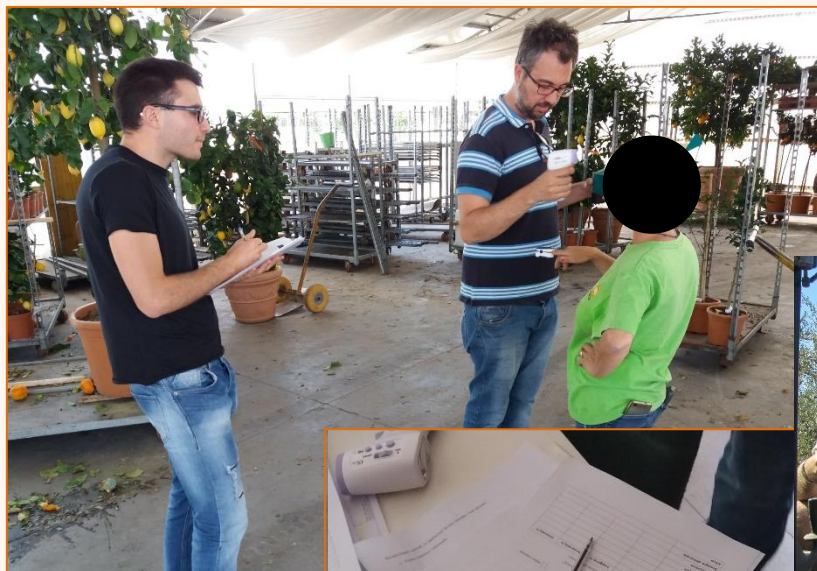


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Monitoraggio comportamentale



- **Questionario generale**
 - somministrato una sola volta in tutta la stagione



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Questionario di percezione termica

ID: _____ Ora (1-24): _____ Minuti (0-60): _____

Data di nascita (giorno/mese/anno): ____/____/____

Luogo di nascita: _____

Descrizione ambiente: _____

Peso: _____

Temperatura corporea: _____

Frequenza cardiaca: _____

Saturimetria: _____

Che attività lavorativa hai svolto nell'ultima ora di lavoro?

☐ Leggera ☐ Moderata ☐ Intensa ☐ Molto intensa

1) Puoi quantificare le situazioni percepite nell'ultima ora di lavoro?

(Indicare con una X le caselle corrispondenti a ciascuna situazione):

Situazioni percepite	Assente	Leggera/o	Moderata/o	Intensa/o
Sudorazione				
Stanchezza				
Sete				
Vertigini				
Spossatezza				
Confusione				
Disagio generale				
Altro				



Quale tipo di sforzo richiede il tuo lavoro?

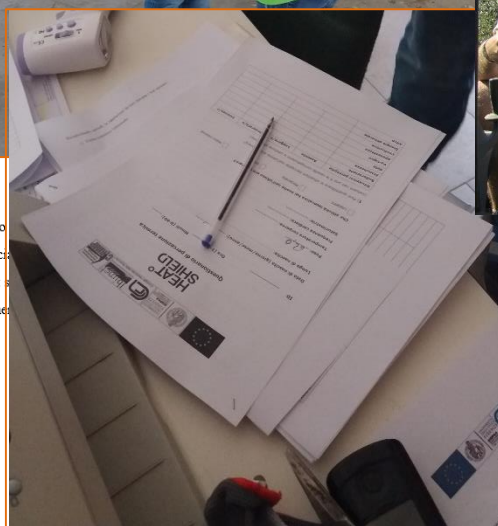
- ☐ Basso (prevalentemente seduto a proprio agio)
- ☐ Moderato (lavoro sostenuto con mani e braccia)
- ☐ Elevato (lavoro intenso con braccia e tronco)
- ☐ Molto elevato (attività molto intensa; movimenti pesanti)

Sei un lavoratore stagionale?

☐ Sì ☐ No

In quale settore lavori?

- ☐ Agricolo
- ☐ Costruzioni
- ☐ Trasporti



- **Questionario di sensazione termica**
 - somministrato all'inizio, a metà ed al termine della giornata lavorativa

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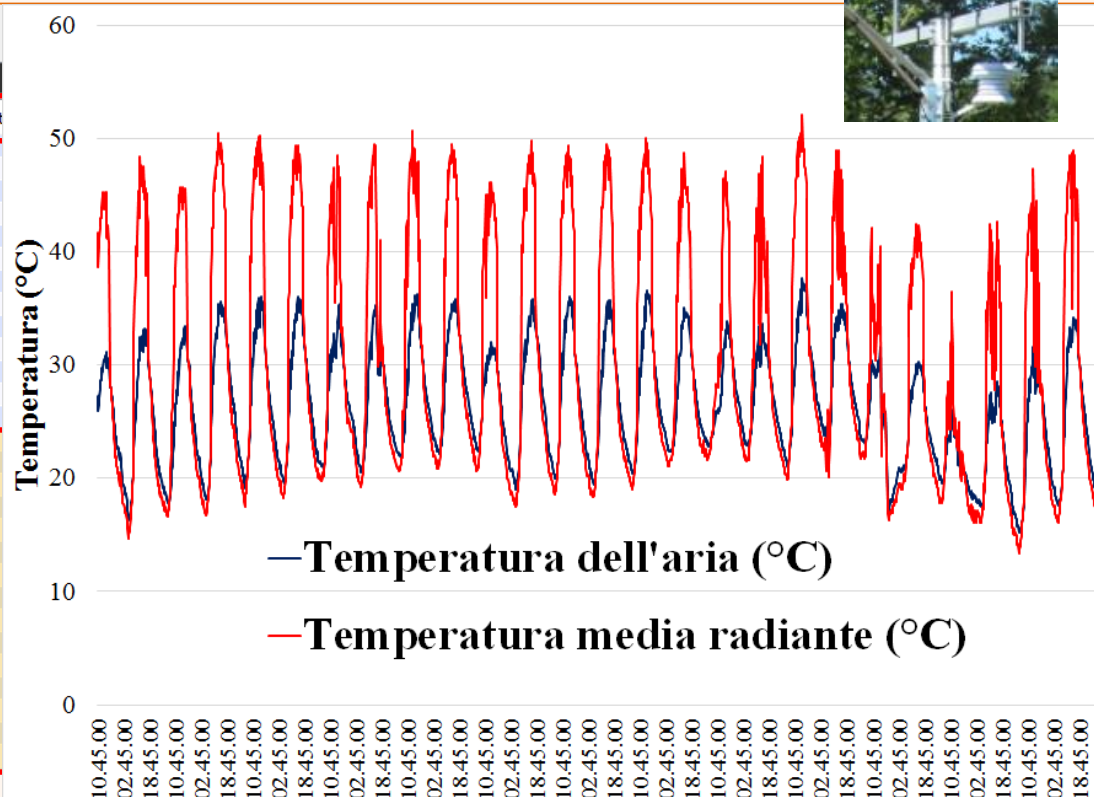
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Database dei dati raccolti

Monitoraggio ambientale



#	Time, GMT+02:00	Wind Direction, ϕ (WD)	Pressure, mbar (P)	Solar Radiat
87	06/09/17 08.15.00 AM	124,9	1.010,950	
88	06/09/17 08.30.00 AM	119,3	1.010,950	
89	06/09/17 08.45.00 AM	109,5	1.011,050	
90	06/09/17 09.00.00 AM	89,9	1.010,850	
91	06/09/17 09.15.00 AM	91,3	1.010,650	
92	06/09/17 09.30.00 AM	105,3	1.010,550	
93	06/09/17 09.45.00 AM	88,4	1.010,650	
94	06/09/17 10.00.00 AM	91,3	1.010,650	
95	06/09/17 10.15.00 AM	74,4	1.010,350	
96	06/09/17 10.30.00 AM	77,2	1.010,250	
97	06/09/17 10.45.00 AM	115,1	1.010,250	
98	06/09/17 11.00.00 AM	96,9	1.010,250	
99	06/09/17 11.15.00 AM	80,0	1.010,050	
100	06/09/17 11.30.00 AM	59,0	1.009,950	
101	06/09/17 11.45.00 AM	112,3	1.010,050	
102	06/09/17 12.00.00 PM	206,4	1.009,950	
103	06/09/17 12.15.00 PM	185,3	1.009,950	
104	06/09/17 12.30.00 PM	233,1	1.009,850	
105	06/09/17 12.45.00 PM	207,8	1.009,850	
106	06/09/17 01.00.00 PM	223,2	1.009,750	
107	06/09/17 01.15.00 PM	206,4	1.009,450	
108	06/09/17 01.30.00 PM	223,2	1.009,350	
109	06/09/17 01.45.00 PM	224,6	1.009,150	
110	06/09/17 02.00.00 PM	192,3	1.009,150	
111	06/09/17 02.15.00 PM	344,0	1.009,050	
112	06/09/17 02.30.00 PM	203,6	1.008,950	
113	06/09/17 02.45.00 PM	59,0	1.008,950	
114	06/09/17 03.00.00 PM	321,5	1.008,650	



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Monitoraggio comportamentale e fisiologico

questionario generale											
1											
2	data di nascita	06/12/1958	06/12/1978	12/12/1980	08/03/1959	18/02/1970	01/05/1964	05/02/1975	08/10/1954	07/11/1968	10/12/1975
3	luogo di nascita	palermo	bronte	marocco	avversa	pistoia	figline	lucca	olbia	germania	romania
4	sezzo	m	m	m	m	m	m	f	f	f	f
5	altezza	179	178	180	169	173	167	156	150	172	164
6	peso	83	72	80	69	80	87	43	48	61	55
7	istruzione	elementare	scuola media	scuola media	scuola superiore	scuola superiore	scuola media	scuola superiore	scuola media	scuola media	scuola superiore
8	reddito medio	sotto media	in media	in media	in media	in media	in media	in media	in media	in media	in media
9	nazionalità	italiana	italiana	marocchin a	italiana	italiana	italiana	italiana	italiana	tedesco	rumena
10	nazione	italia	italia	italia	italia	italia	italia	italia	italia	italia	italia
11	regione	toscana	toscana	toscana	toscana	toscana	toscana	toscana	toscana	toscana	toscana
12	tipo di sforzo richiesto	moderato	moderato	molto elevato	elevato	elevato	moderato	moderato	molto elevato	elevato	moderato
13	lavoratore stagionale	si	si	si	no	no	si	no	no	no	no
14	settore lavorativo	costruzioni	costruzioni	costruzioni	costruzioni	costruzioni	costruzioni	agricolo	agricolo	agricolo	agricolo
15	da quanti anni nel settore	43	13	7	30	32	31	20	17	17	14
16	ore al giorno di lavoro all'aperto in estate	8	8	8	8	8	10	0	0	0	0
17	ore al giorno in ambiente confinato in estate	0	0	0	0	0	10 escavatore	8	8	8	8

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Previsione del rischio per fascia oraria

00:00-06:00
6:00-12:00
12:00-18:00
18:00-24:00



SISTEMA DI ALLERTA DA CALDO PER I LAVORATORI

PROGETTO PREVISIONE INFO LOGIN ITALIANO ENGLISH

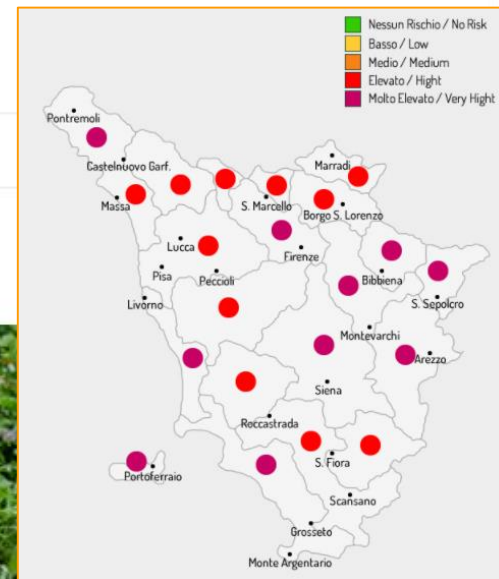
GIORNALIERA

ORARIA (FASCIA ORARIA)

SETTIMANALE (FINO A 1 MESE)



Previsione di allerta caldo fino a 5 giorni



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Il rischio viene calibrato per diversi soggetti



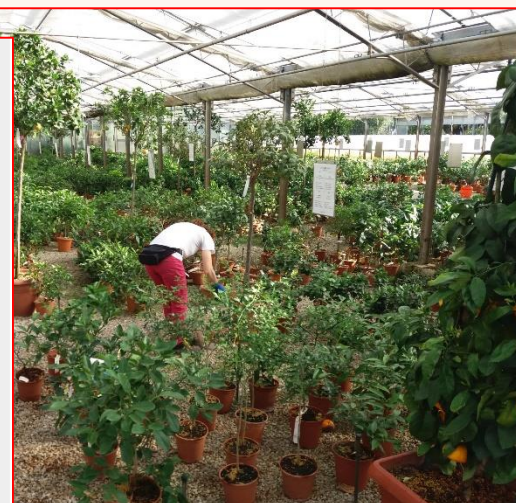
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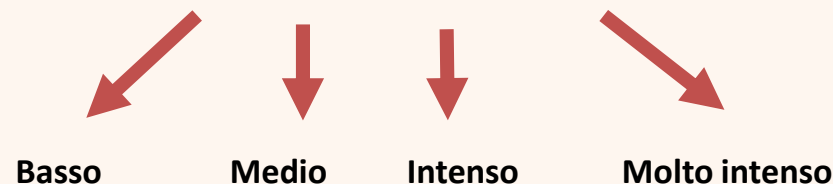
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Allerte specifiche per soggetto che lavora al sole o all'ombra



Allerte specifiche per diverse intensità di sforzo



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Consigli sul comportamento da adottare

Avvisi Consumo Idrico

+

Soggetto Acclimatato al Sole - Consumo Idrico

+

Soggetto Non Acclimatato al Sole - Consumo Idrico

+

Soggetto Acclimatato all'Ombra - Consumo Idrico

+

Soggetto Non Acclimatato all'Ombra - Consumo Idrico

Avvisi Pausa Oraria

+

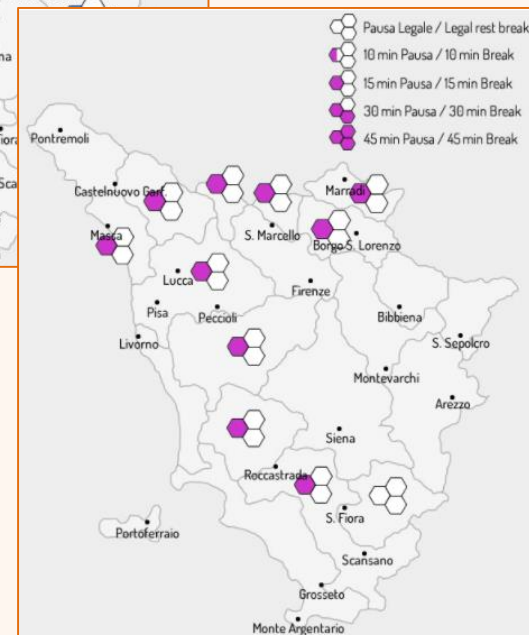
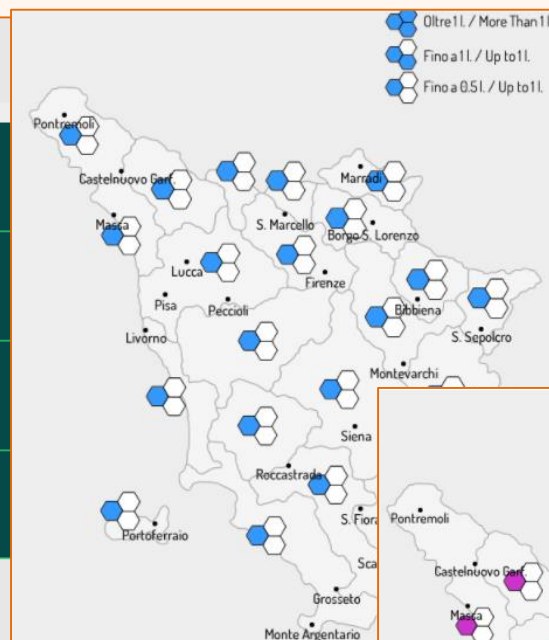
Soggetto Acclimatato al Sole - Pausa Oraria

+

Soggetto Non Acclimatato al Sole - Pausa Oraria

+

Soggetto Acclimatato all'Ombra - Pausa Oraria



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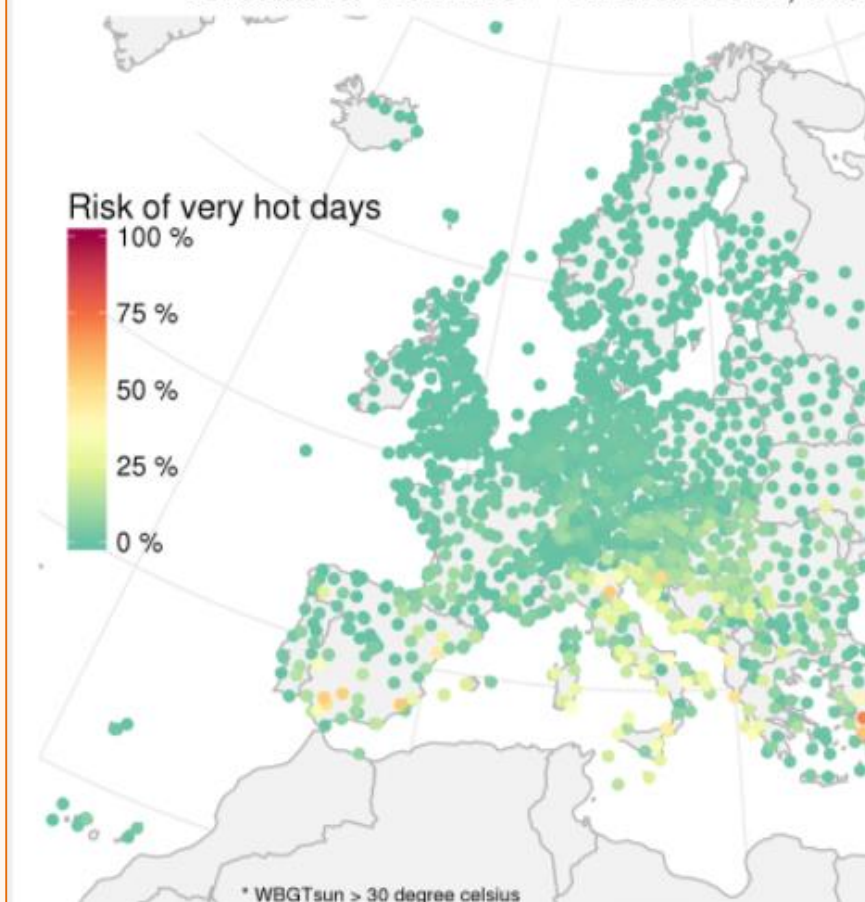
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Previsione della probabilità di rischio caldo fino a 4 settimane

Forecast for Mon 17.07 - Fri 21.07.2017, issued on 03.07.2017



Toscana Settimana 2 - WBGT Sopra 30 °C

Calendario Toscana

Forecast for Mon 17.07 - Fri 21.07.2017, issued on 03.07.2017



FIRENZE

MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY
			08/06	09/06	10/06	11/06
12/06	13/06	14/06	15/06	16/06	17/06	18/06
19/06	20/06	21/06	22/06	23/06	24/06	25/06
26/06	27/06	28/06	29/06	30/06	01/07	02/07
03/07	04/07	05/07	06/07	07/07	08/07	09/07
10/07	11/07	12/07	13/07	14/07	15/07	16/07
17/07	18/07	19/07	20/07	21/07	22/07	23/07

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based on ECMWF
forecast of 03.07.2017

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forecast of 03.07.2017

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**GRAZIE PER
L'ATTENZIONE!!!**

<https://www.heat-shield.eu/>

Un personale ringraziamento ai referenti e dipendenti di:

- ✓ Azienda agricola il Palagio <http://www.palagioproducts.com/>
- ✓ Azienda agricola Oscar Tintori <http://www.oscartintori.it/>
- ✓ Cantiere della tramvia di Firenze: Conglomerati spa - Cromoter srl - Rosi Leopoldo spa - Donatello spa - New Edil Costruzioni srl

Per ulteriori informazioni:

Marco Morabito, Istituto di Biometeorologia - Consiglio Nazionale delle Ricerche
m.morabito@ibimet.cnr.it