



# 7<sup>th</sup> Symposium on Fire and Forest Meteorology 23-25 October 2007, Bar Harbor, Maine

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## Assessment of an integrated fire rating index for Sardinia, Italy



A.D. MDLXII



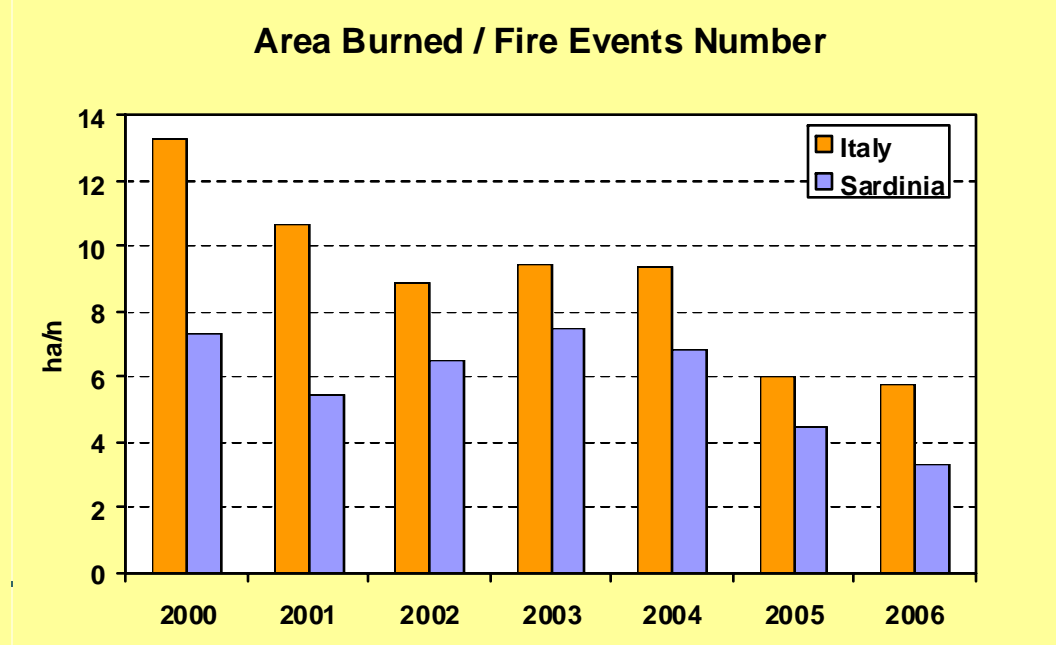
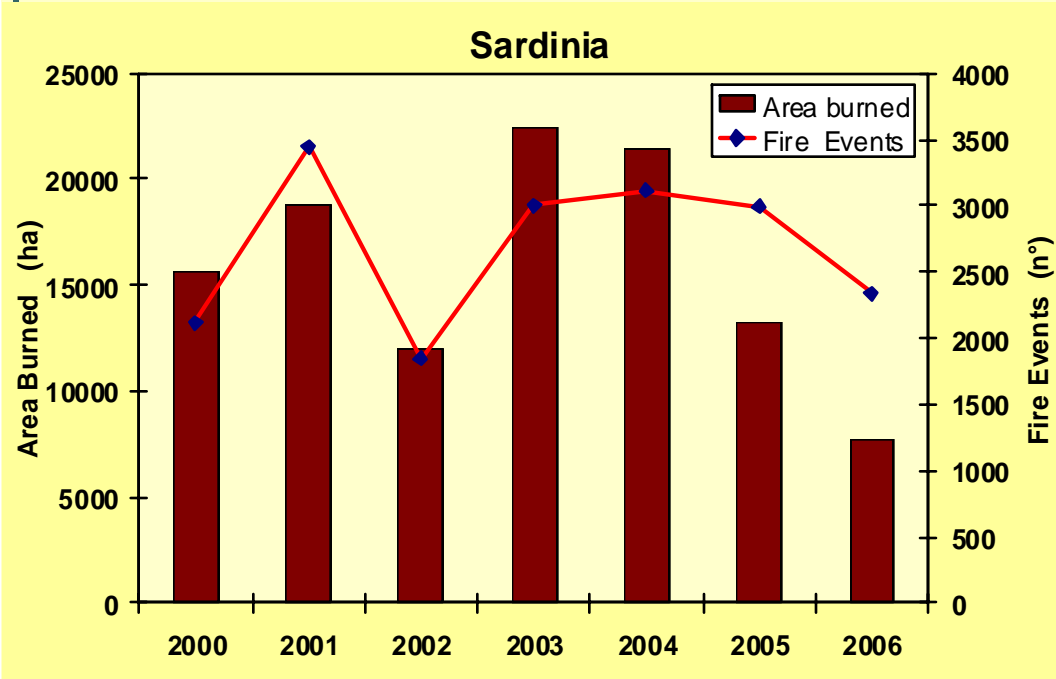
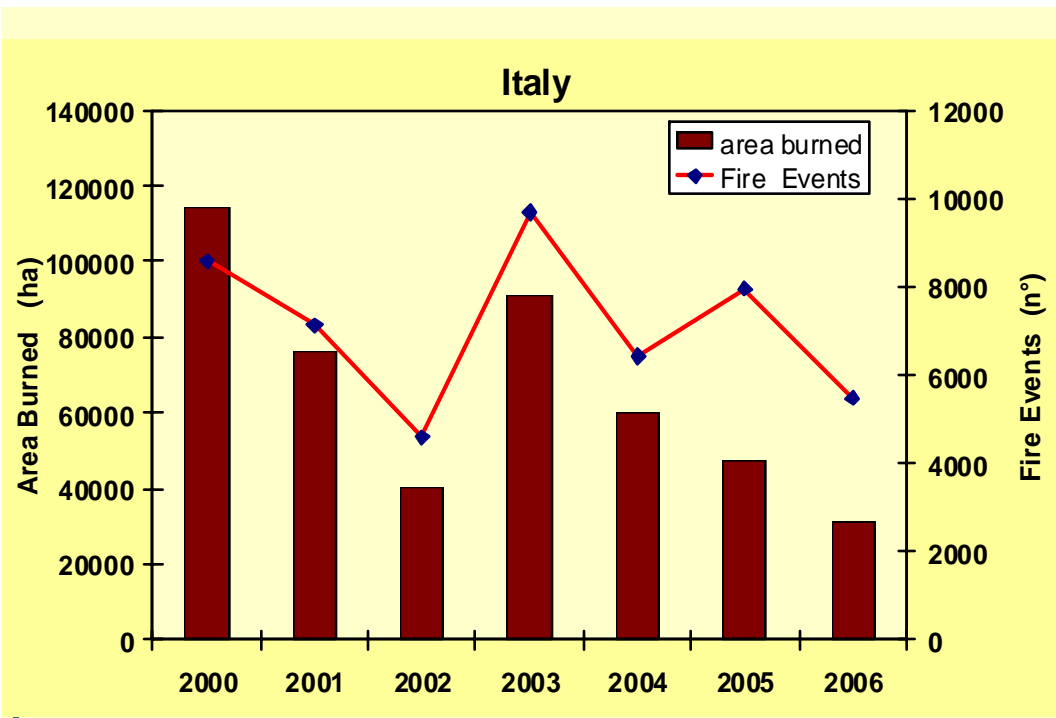
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# Ichnusa Fire Index

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At the beginning of the nuragic age circa 1500 BC, Sardinia was called *Hyknusa* (latinized **Ichnusa**) by the Mycenaeans. The meaning is probably island (*nusa*) of the Hyksos - the people who had just been expelled by Ahmose I of Egypt circa 1540 BC.

# Ichnusa Fire Index

(Spano et al., 2003; Sirca et al., 2006, Sirca et al., 2007)

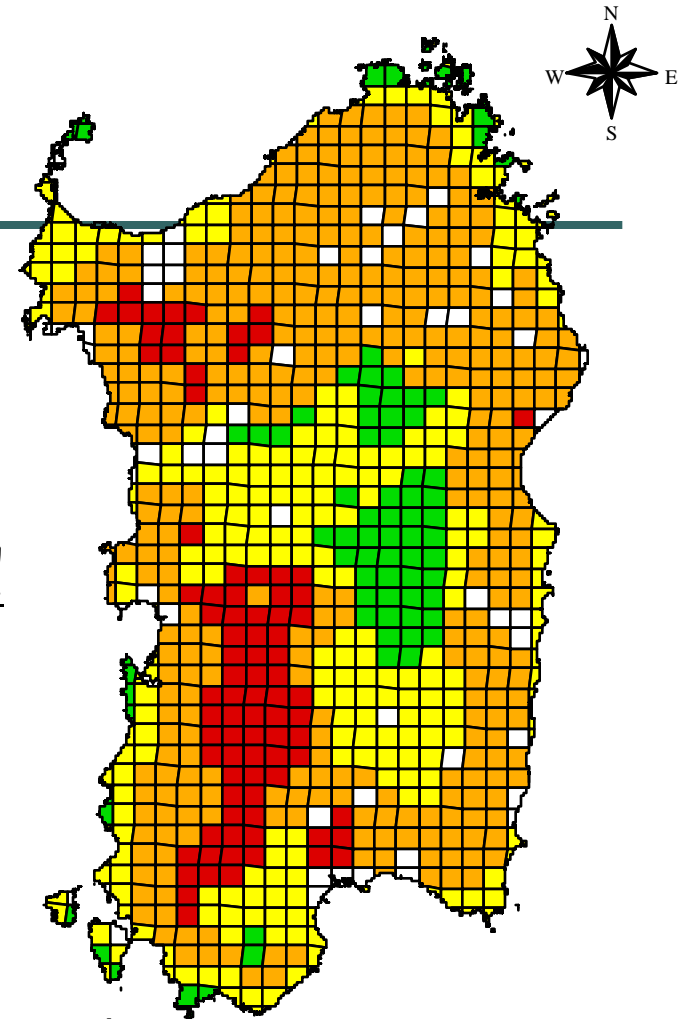
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$$IFI = DC + MC + FC + TC$$

- DC - Drought Code** describing water status of plants
- MC – Meteorological Code** related to the weather conditions
- TC - Topological Code** describing topography, slope, and exposure
- FC - Fuel Code** accounts for structure and moisture of fuel

IFI values are normalized to danger classes 1 to 5

	<u>Danger Class</u>	<u>Burn Sfc Class (ha)</u>	<u>IFI Threshold</u>
1	Very low	0	5.5
2	Low	0↔10	5.5↔8.5
3	Medium	10↔100	8.5↔10.0
4	High	100↔500	10.0↔11.5
5	Extreme	>500	>11.5



# Meteorological input data for Evaluation

- Measured
- Forecast
- By scenario

IFI ver. 1.3

**IFI - ICHNUSA FIRE INDEX**

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Con il supporto del Corpo Forestale e di Vigilanza Ambientale e della Fondazione Banca di Sardegna

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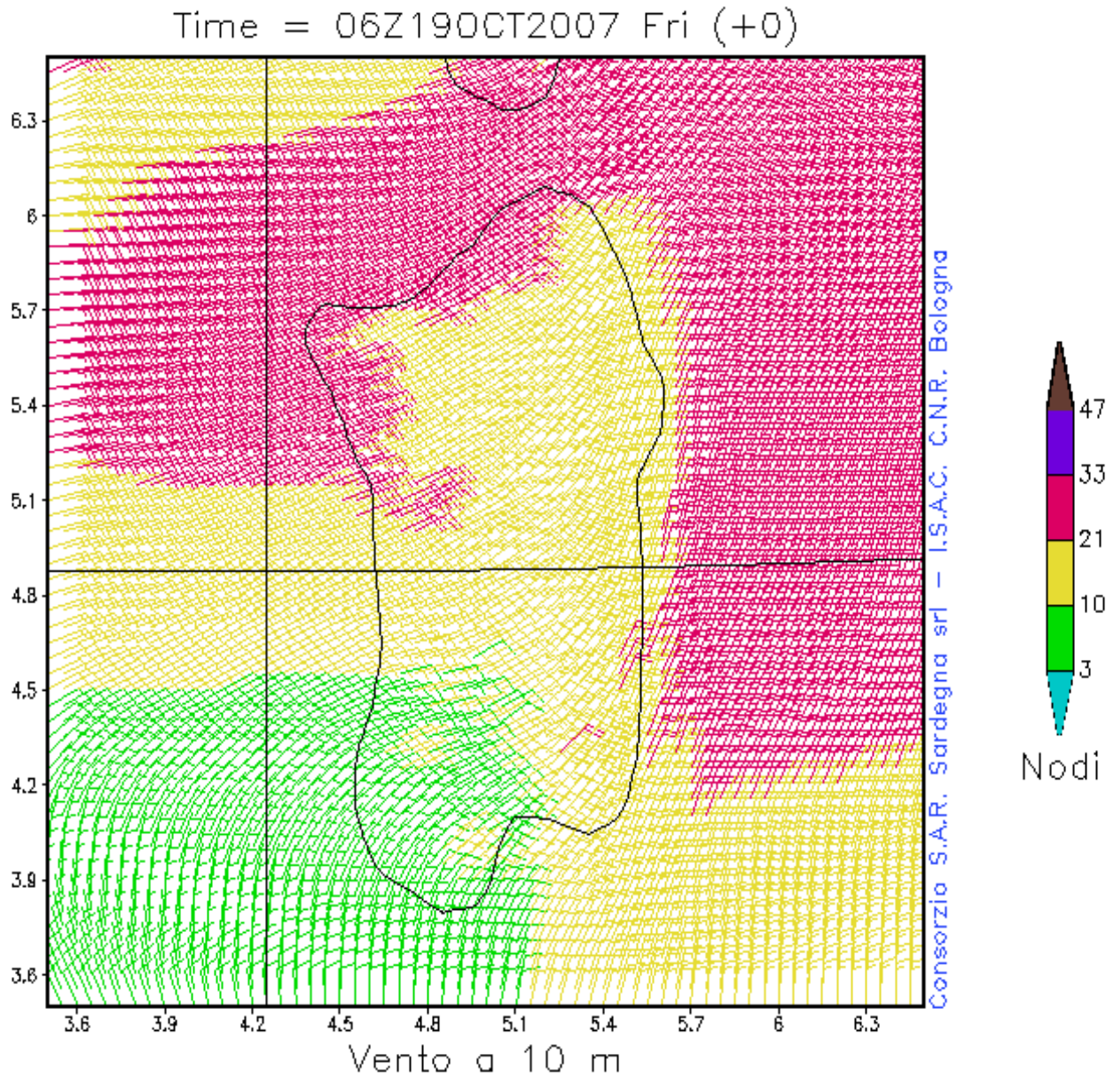
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# *IFI performance*

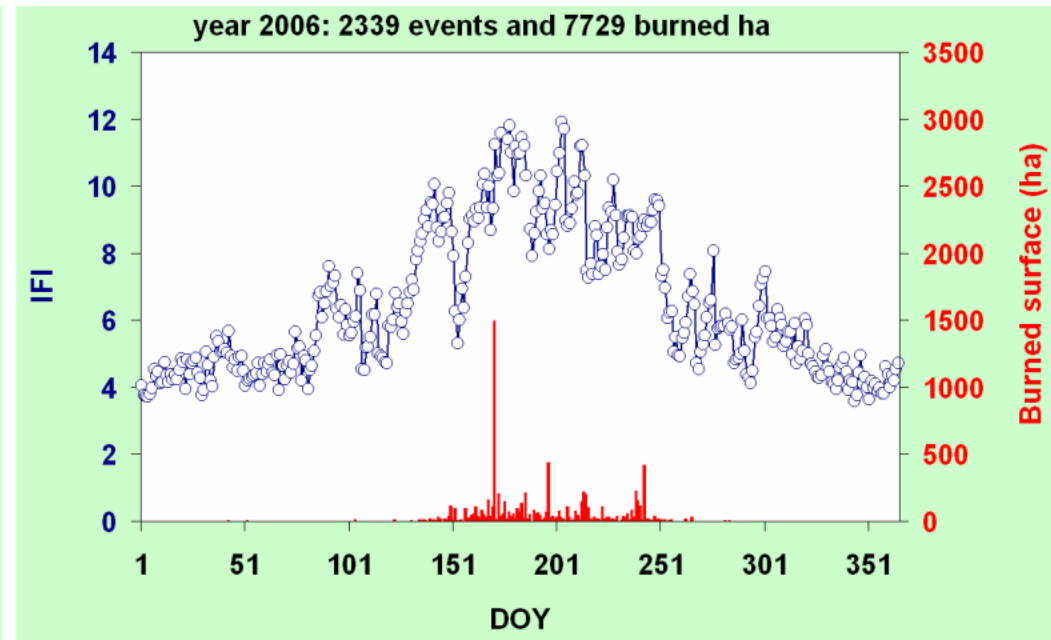
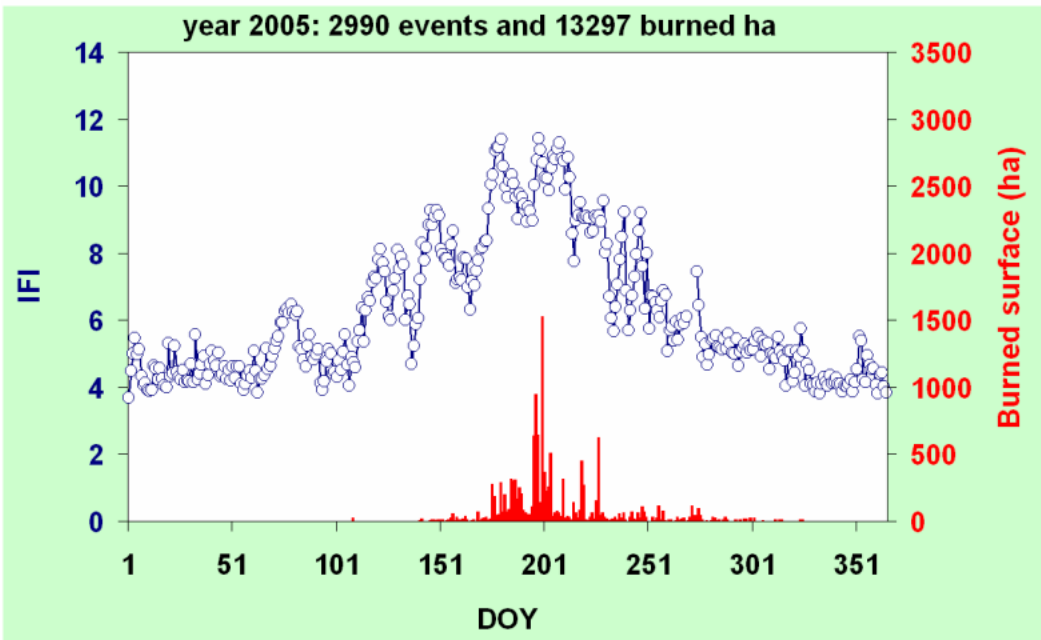
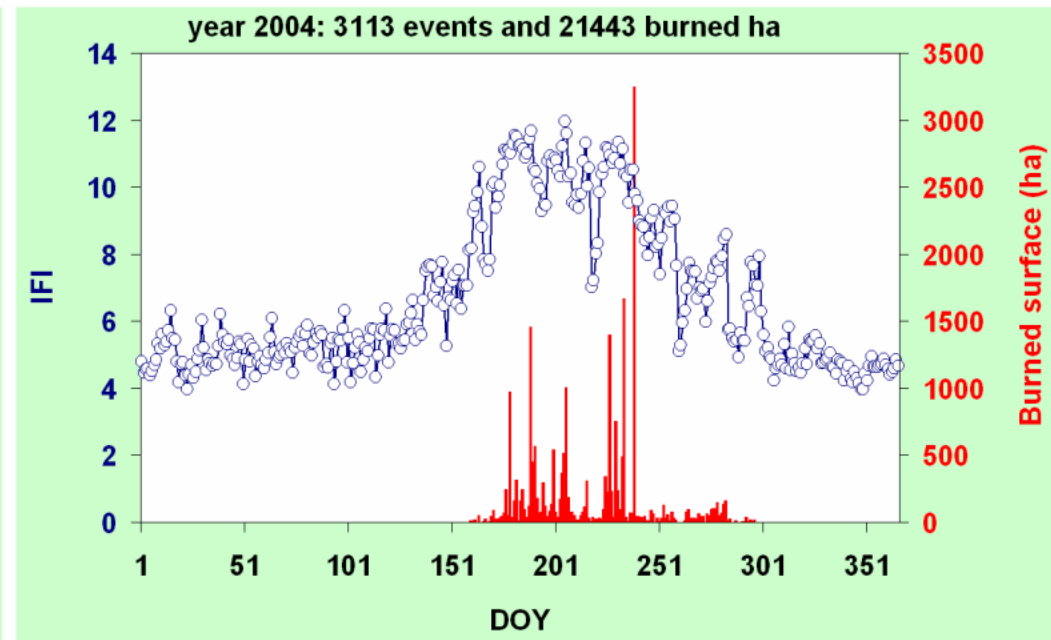
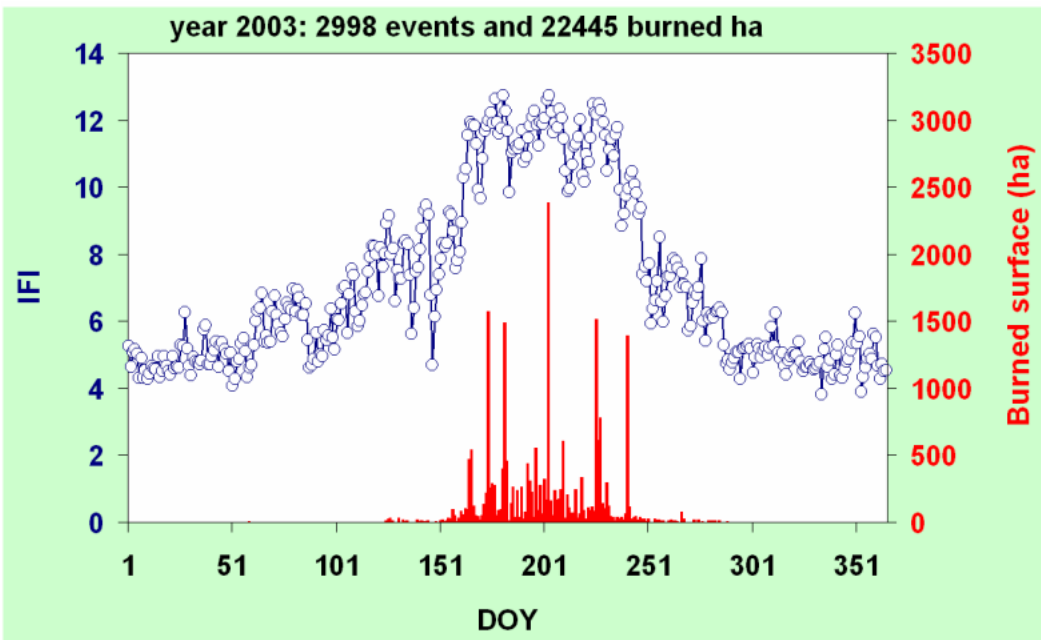
- Using **weather data** for years 2000 – 2006
- From 57 stations of the **Sardinia Agrometeorological Regional (SAR) network**



- Using a **weather forecast** from a limited area model (BOLAM) with a 5 x 5 km grid resolution
- 2005 and 2006 summer periods
- 3422 fire events  
14962 ha burned







## # days within each danger class

**2000 2001 2002 2003 2004 2005 2006**

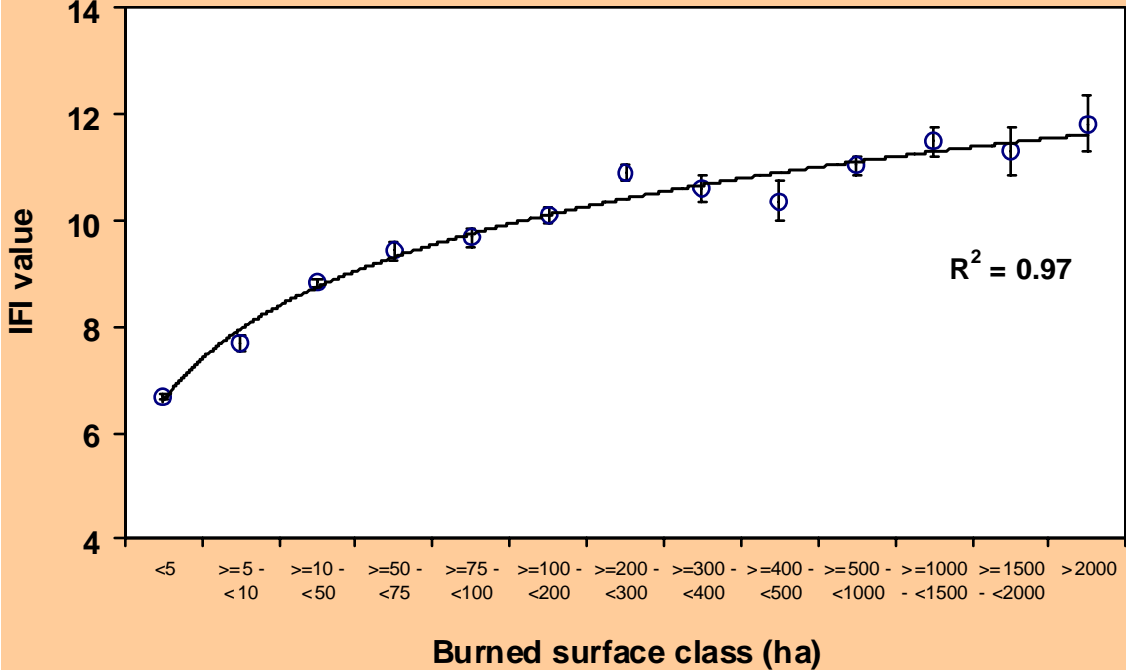
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<b>1</b>	<b>10</b>	<b>2</b>	<b>11</b>	<b>20</b>	<b>18</b>	<b>30</b>	<b>21</b>
<b>2</b>	<b>75</b>	<b>72</b>	<b>103</b>	<b>67</b>	<b>81</b>	<b>85</b>	<b>74</b>
<b>3</b>	<b>42</b>	<b>43</b>	<b>31</b>	<b>24</b>	<b>32</b>	<b>39</b>	<b>59</b>
<b>4</b>	<b>42</b>	<b>52</b>	<b>26</b>	<b>30</b>	<b>49</b>	<b>26</b>	<b>23</b>
<b>5</b>	<b>15</b>	<b>15</b>	<b>13</b>	<b>43</b>	<b>4</b>	<b>0</b>	<b>4</b>

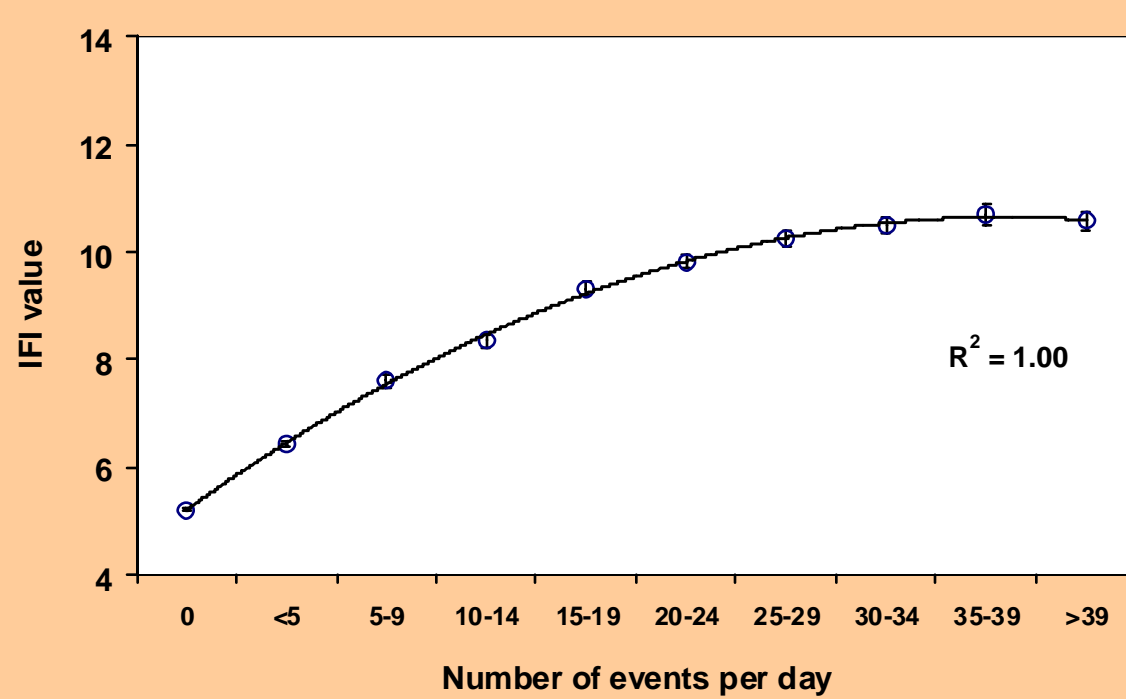
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# Period 2000-2006

Overall mean daily IFI value vs observed burned surfaces



Overall mean daily IFI value vs observed event number

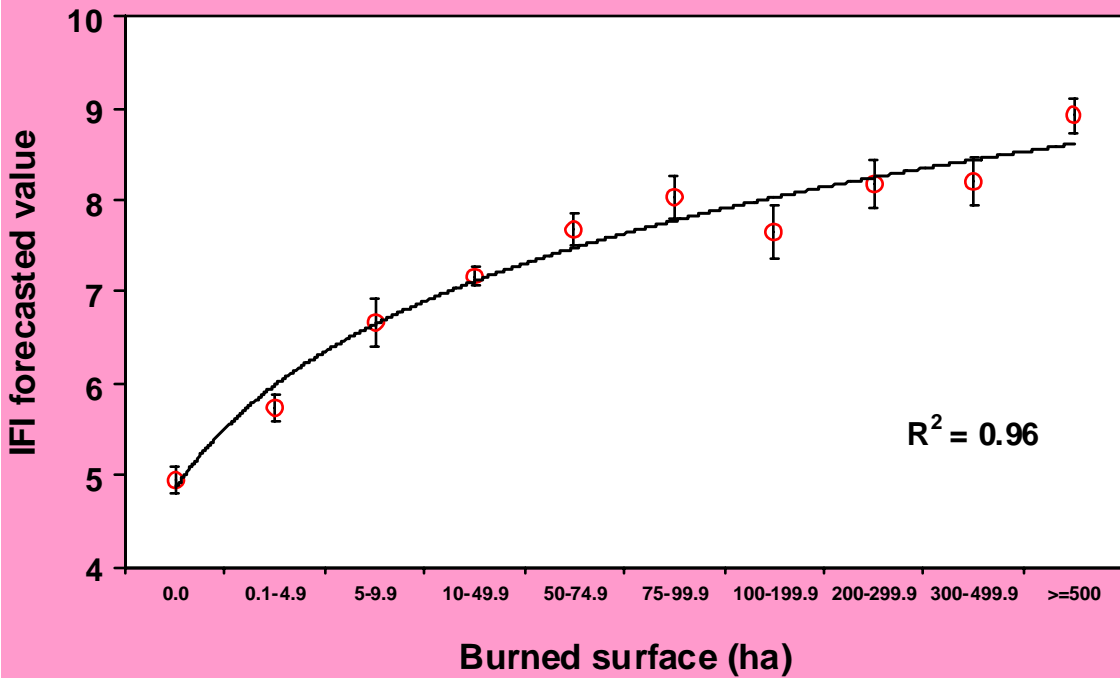


## Period: 2000-2006

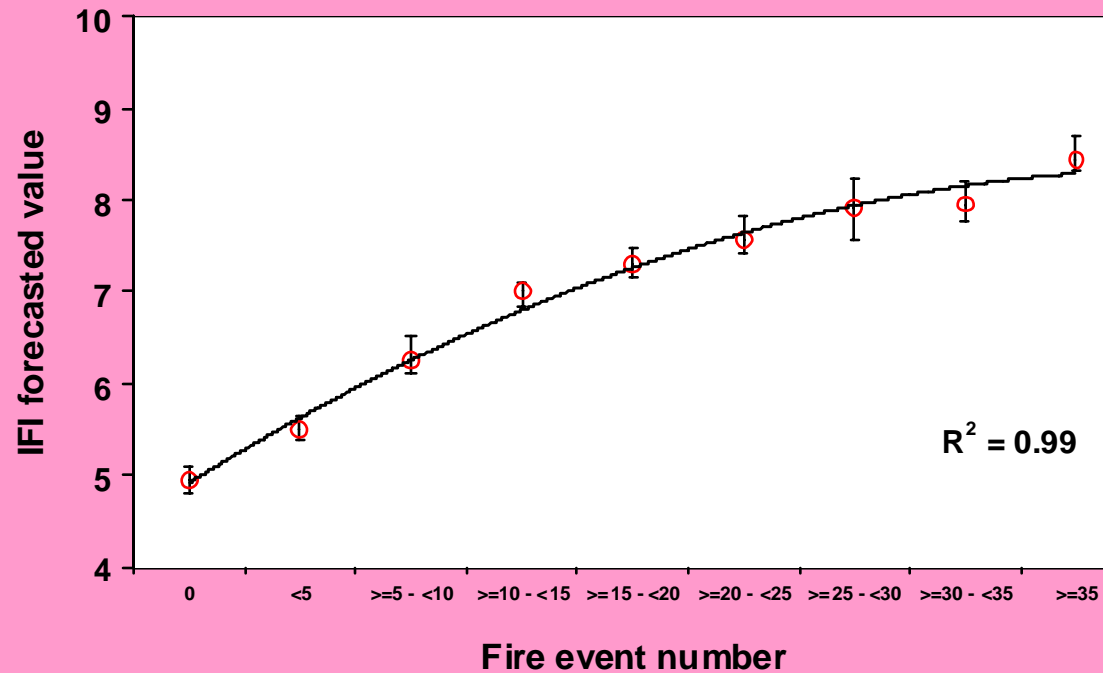
<b>Days</b>	Annual <b>2549</b>	APRIL-OCTOBER <b>1491</b>	JULY-AUGUST <b>433</b>
Underestimate (2 Classes)	<b>1.5%</b>	<b>2.5%</b>	<b>2.8%</b>
Underestimate (1 Class)	<b>12.0%</b>	<b>17.6%</b>	<b>15.9%</b>
<b>Exact Prediction</b>	<b>59.7%</b>	<b>45.7%</b>	<b>43.4%</b>
Overestimate (1 Class)	25.3%	31.7%	31.9%
Overestimate (2 Classes)	1.5%	2.5%	6.0%
<b>Conservative Prediction</b>	<b>86.5%</b>	<b>79.9%</b>	<b>81.3%</b>

# 2005 and 2006 summer periods

Overall mean daily IFI from weather forecast and observed burned surface



Overall mean daily IFI from weather forecast and event number



# JULY- SEPTEMBER 2005 - 2006

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<b>Days</b>	<b>170</b>
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<b>Underestimate (2 Classes)</b>	<b>0.0%</b>
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<b>Underestimate (1 Class)</b>	<b>22.9%</b>
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<b>Exact Prediction</b>	<b>56.5%</b>
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<b>Overestimate (1 Class)</b>	<b>20.6%</b>
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<b>Overestimate (2 Classes)</b>	<b>0.0%</b>
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<b>Conservative Prediction</b>	<b>77.1%</b>
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# IFI performance

- Y 2000-2004
- 57 areas corresponding to weather stations of Agrometeorological Sardinia Regional SAR service
- Comparison with the Canadian *FWI*, Portuguese *Port*, and Italian *IMPI*

## Statistical test

- **Mahalanobis distance** (DM) test described by Lefebvre (1983)
- **The “Score 1”, “Score 2”, and “Score 3” tests** were described by Mandallaz and Ye (1996) and Bovio and Camia (1997)
- Fire events that occurred within 20 to 40 km around each station were included in the statistical analysis.

# Mahalanobis distances for four indexes

<b>MODEL</b>	<b>MD (20 km)</b>	<b>MD (40 km)</b>
<b>IFI</b>	<b>1.23</b>	<b>1.16</b>
FWI	0.84	0.85
IMPI	1.06	0.85
PORT	0.44	0.46



## *Values of Scores 1, 2 and 3 for four indexes*

	20 km			40 km		
MODEL	Score 1	Score 2	Score 3	Score 1	Score 2	Score 3
<b>IFI</b>	<b>0.82</b>	<b>1.55</b>	<b>0.62</b>	<b>0.82</b>	<b>1.50</b>	<b>0.60</b>
<b>FWI</b>	<b>0.78</b>	<b>1.48</b>	<b>0.53</b>	<b>0.80</b>	<b>1.46</b>	<b>0.59</b>
<b>IMPI</b>	<b>0.80</b>	<b>1.52</b>	<b>0.57</b>	<b>0.79</b>	<b>1.44</b>	<b>0.53</b>
<b>PORT</b>	<b>0.70</b>	<b>1.34</b>	<b>0.37</b>	<b>0.73</b>	<b>1.33</b>	<b>0.40</b>

## *Conclusions*

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- The number of fire events was positively correlated with the IFI calculations
- The area burned was highly correlated with daily IFI values
- The forecast data input and weather data input resulted in similar IFI performance
- The IFI performed better than other fire danger indexes under Sardinia conditions

THE END



Thanks

**Ciao from Jena, Germany**