LA RISPOSTA DEGLI UCCELLI EUROPEI AI CAMBIAMENTI CLIMATICI: UN NUOVO APPROCCIO

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GLOBAL CHANGE
IGBP International Geosphere-Biosphere Programme

ICSU International Council for Science

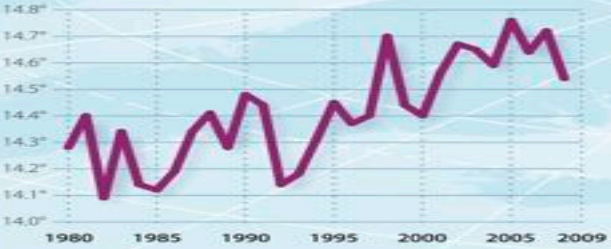
IGBP CLIMATE-CHANGE INDEX

Global-change trends for the public and policymakers

SEA LEVEL
(millimetres)

Source: Church and White global mean sea-level reconstruction (CSIRO), using data from the Permanent Service for Mean Sea Level, Proudman Oceanographic Laboratory, Natural Environment Research Council

GLOBAL AVERAGE TEMPERATURE
(degrees C)



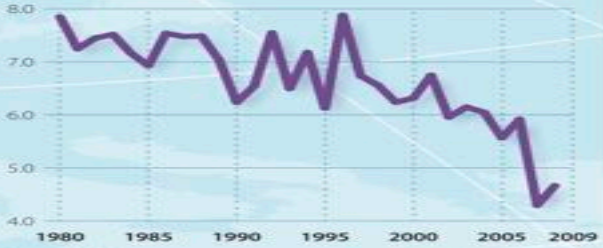
Source: NASA

Cumulative annual change
(normalised annually between -100 and +100)

ATMOSPHERIC CO_2
(parts per million by volume)

Source: Carbon Dioxide Information Analysis Center, Mauna Loa

ARCTIC SEA-ICE COVER
Northern hemisphere summer sea-ice minimum
(millions of square kilometres)



Source: NOAA

Rising index
A shift away from a relatively stable climate

Falling index
A shift towards a relatively stable climate

The IGBP climate-change index combines the four key metrics that help unravel what is happening to the planet: temperature, carbon dioxide levels, sea level and Arctic sea ice. The index combines annual changes in each of these directly-measured parameters. Each year's change is added to the previous year. Natural variability sometimes obscures general trends in these metrics. By drawing together the four metrics as a single figure, the IGBP climate-change index exposes the underlying trend.

Conseguenze del CC sugli uccelli

Stime dei tassi di estinzione in 4 regioni (2050)

Regione	Tasso previsto di estinzione		Scenario	Numero attuale di specie
	Minimo	Massimo		
Europa	4-6%	13-38%	> 2°C	525
Sud Africa	28-32%	33-40%	1,8 – 2,0 °C	951
Australia e Tropici	49-72%	N/A	> 2 °C	740 (in Australia)
Messico	3-4%	5-8%	1,8 – 2,0 °C	1.060

Thomas et al. *Nature* 427: 145-148 (2004)

Effetti principali del CC sugli uccelli

- **Effetti sul sincronismo ecologico**
  - Data di deposizione
  - Fenologia e comportamento

- **Effetti sulle dinamiche di popolazione**
  - Successo riproduttivo
  - Mortalità

- **Effetti a livello di comunità e areale**
  - Composizione comunità
  - Distribuzione e areale

La distribuzione delle specie è frutto dell'interazione tra diverse componenti (storica, biotica, climatica, di habitat) che influiscono a scala differente.

Modelli bioclimatici *(scala biogeografica)*

Dati di presenza + **Set di variabili climatiche** = **Distribuzione potenziale della specie**

Modelli bioclimatici *(scala biogeografica)*

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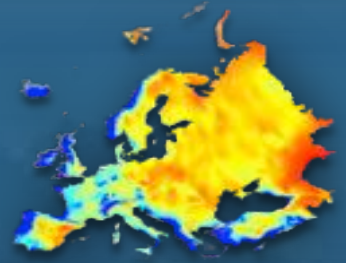
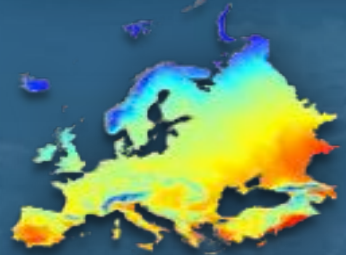
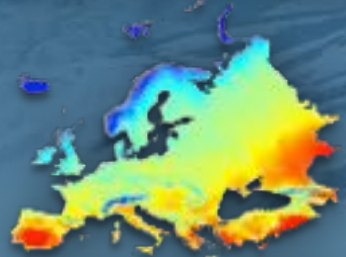


Precip. max primavera



Temp. media estate



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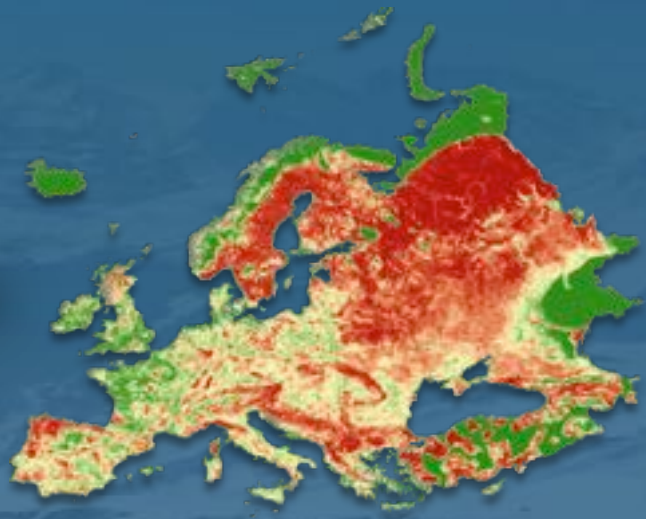
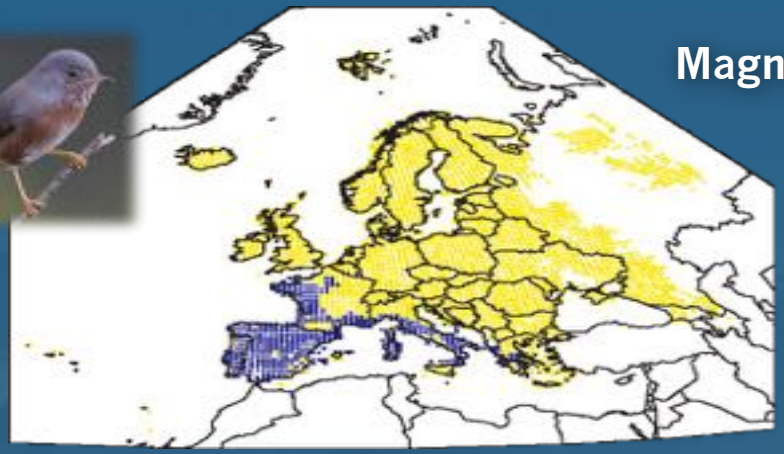
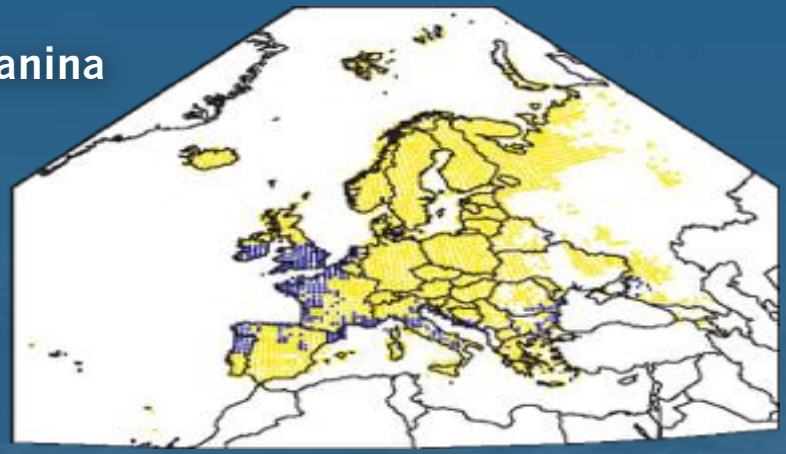


Magnanina

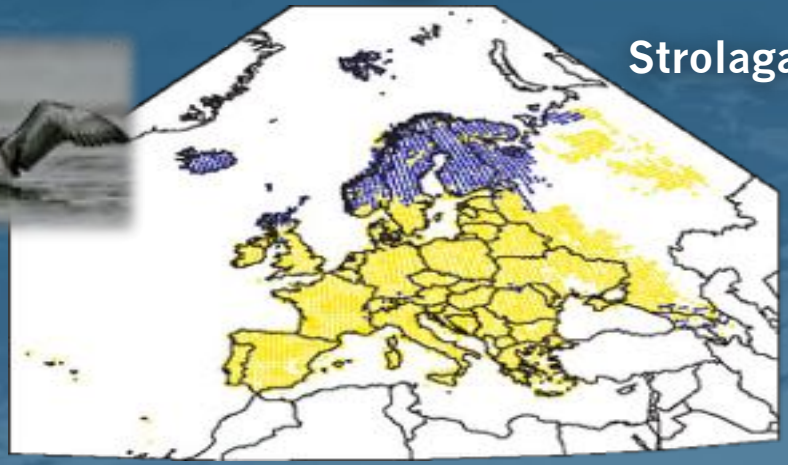


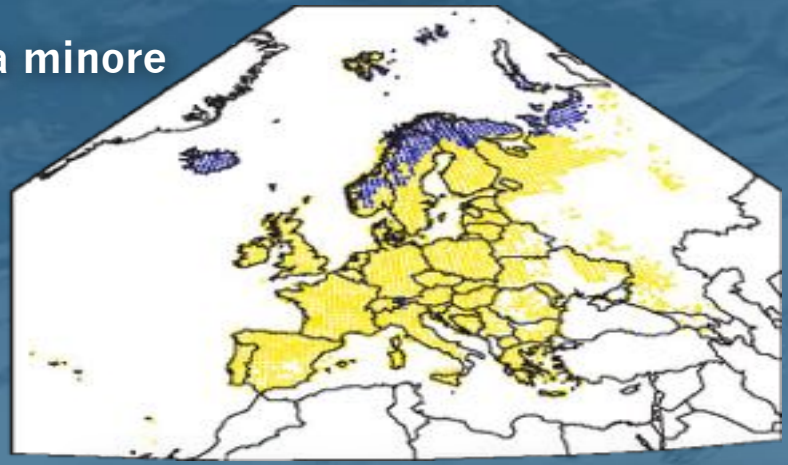


Oggi

2070

Strolaga minore





Huntley et al. *Ibis* 148: 8-28 (2006)

Modelli expert-base *(scala locale)*

ECOLOGICAL FORM

SPECIE *Turdus merula*

ALTITUDINE 0-1500 m

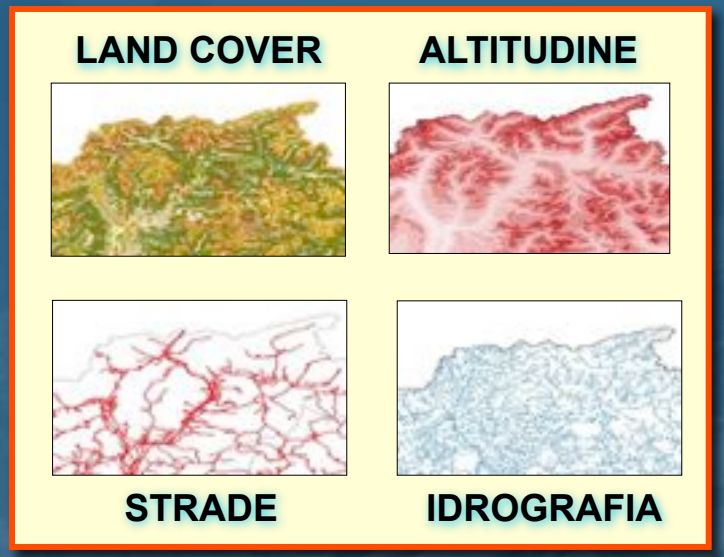
DISTANZA ACQUA 0 m

HABITAT TYPE SCORES

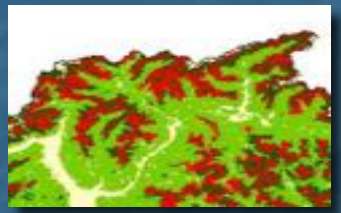
Aree coltivate	1
Bosco di latifoglie	3
Pascoli montani	0
Parchi urbani	3

…

INPUT

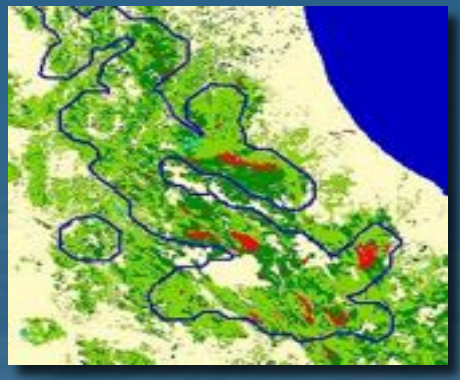


Elaborazione GIS



OUTPUT

Modello di idoneità ambientale per l' AQUILA REALE

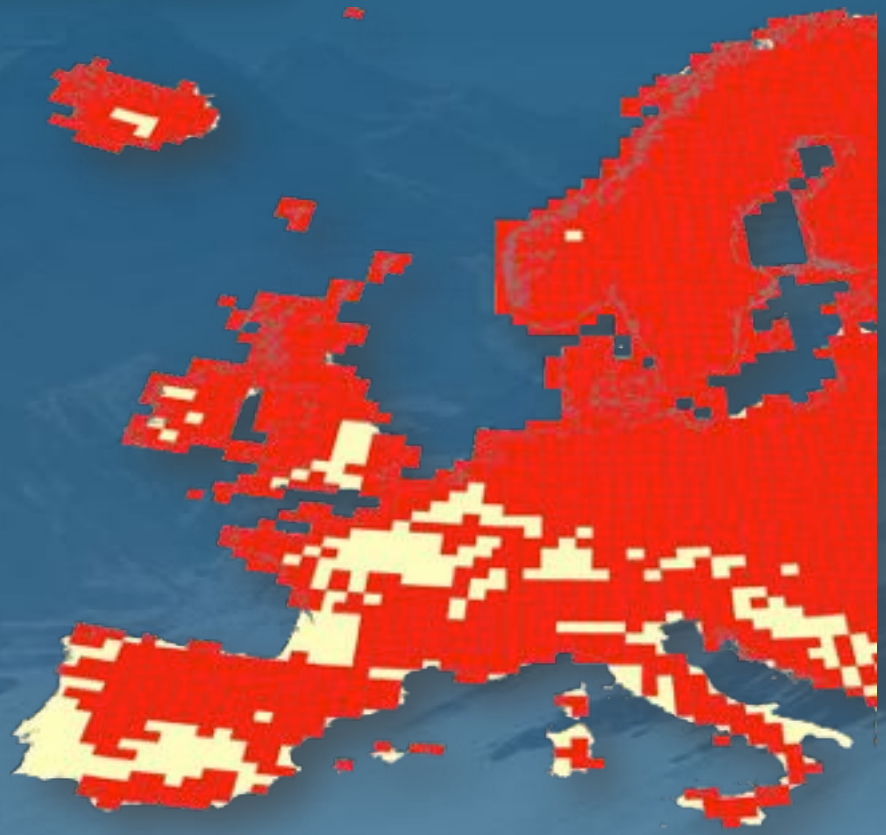


Maiorano et al. *Cons. Biol.* (2007)

Modelli combinati *(scala biogeografica + locale)*

Step 1: Modello bioclimatico

Dati di presenza:



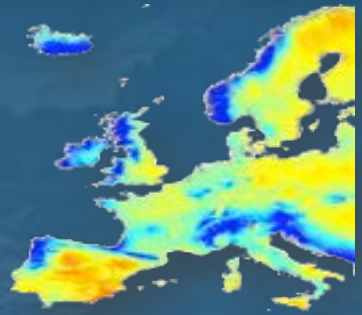
EBCC

European Bird Census Council

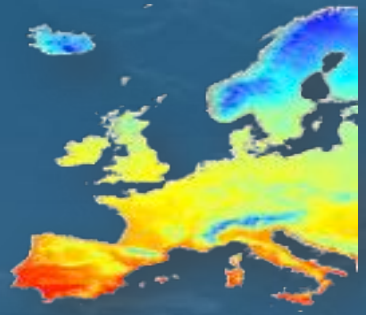
Modelli combinati *(scala biogeografica + locale)*

Step 1: Modello bioclimatico

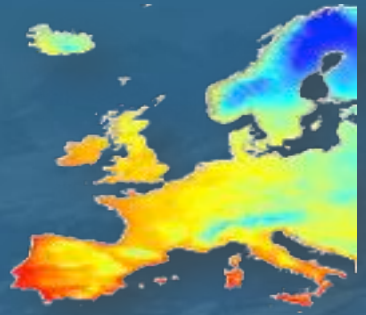
Variabili climatiche:



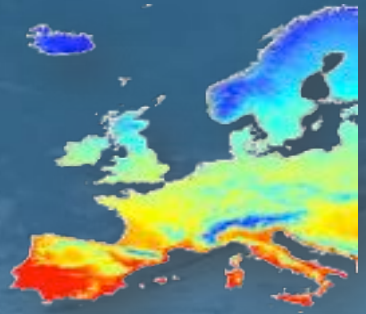
Precipit. tot. annuale



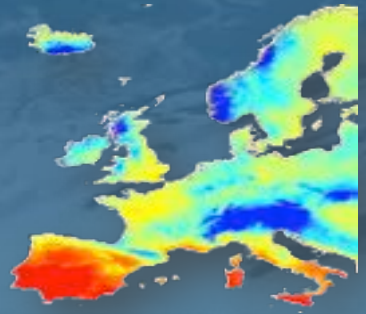
Temp. media annuale



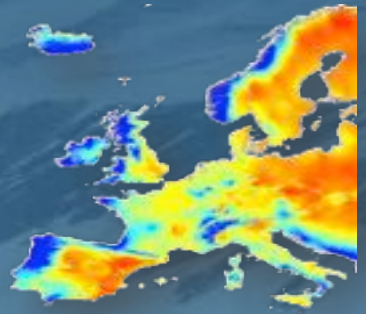
Temp. min. mese più freddo



Growing degree days



Precipit. tot. estiva

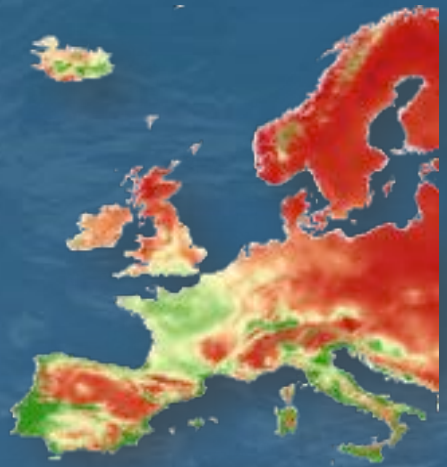


Precipit. tot. invernale

Modelli combinati *(scala biogeografica + locale)*

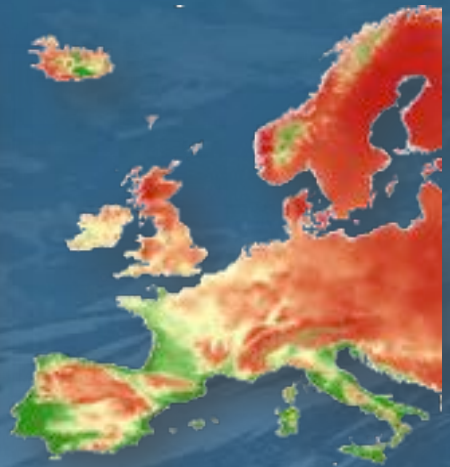
Step 1: Modello bioclimatico

Modelli di distribuzione :



GAM

GBM



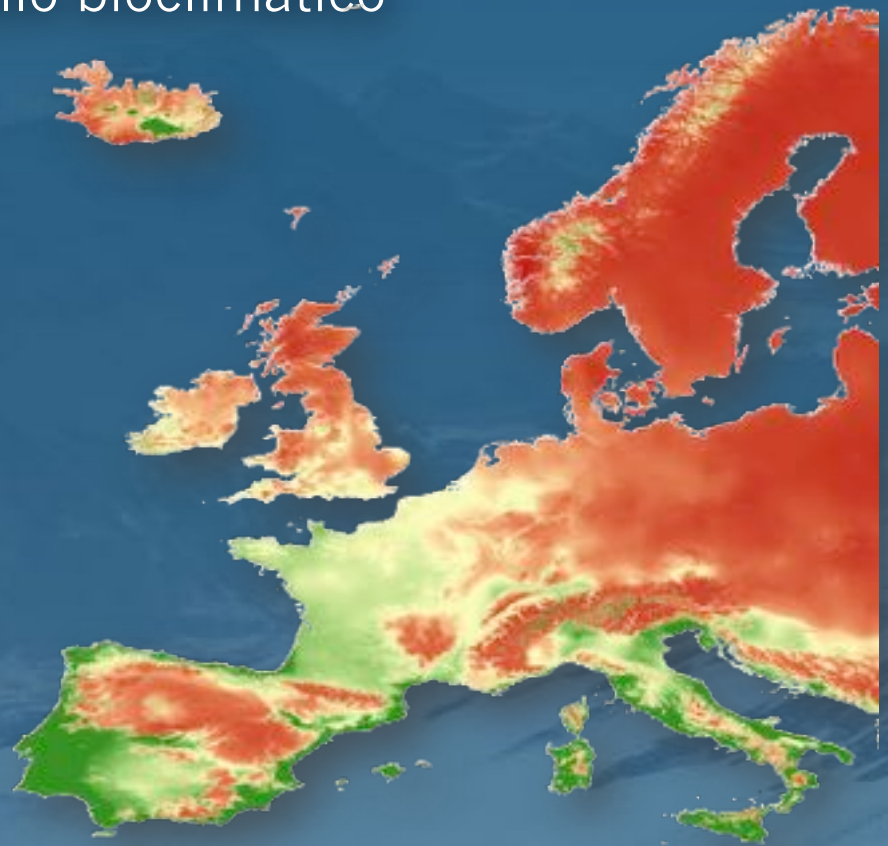
GLM

MAXENT

Modelli combinati *(scala biogeografica + locale)*

Step 1: Modello bioclimatico

Modello:



Modelli combinati *(scala biogeografica + locale)*

Step 1: Modello bioclimatico

Modello:

Modelli combinati *(scala biogeografica + locale)*

Step 2: Modello expert-base

Database:

HABITAT TYPE SCORE

Cultivated and Managed areas	1
Closed to open (>15%) broadleaved deciduous shrubland (<5m)	1
Open (15-40%) broadleaved deciduous shrubland (<5m)	2
Artificial surfaces and associated areas (Urban areas >50%)	2
Consolidated bare areas (hardpands, gravels, bare rock, stones)	0
...	...

DISTANZA DALL'ACQUA/COSTA

Dipendenza acqua (metri)	100
Dipendenza costa (metri)	1000

ALTITUDINE

Altitudine MIN	600
Altitudine MAX	1250

Modelli combinati *(scala biogeografica + locale)*

Step 2: Modello expert-base

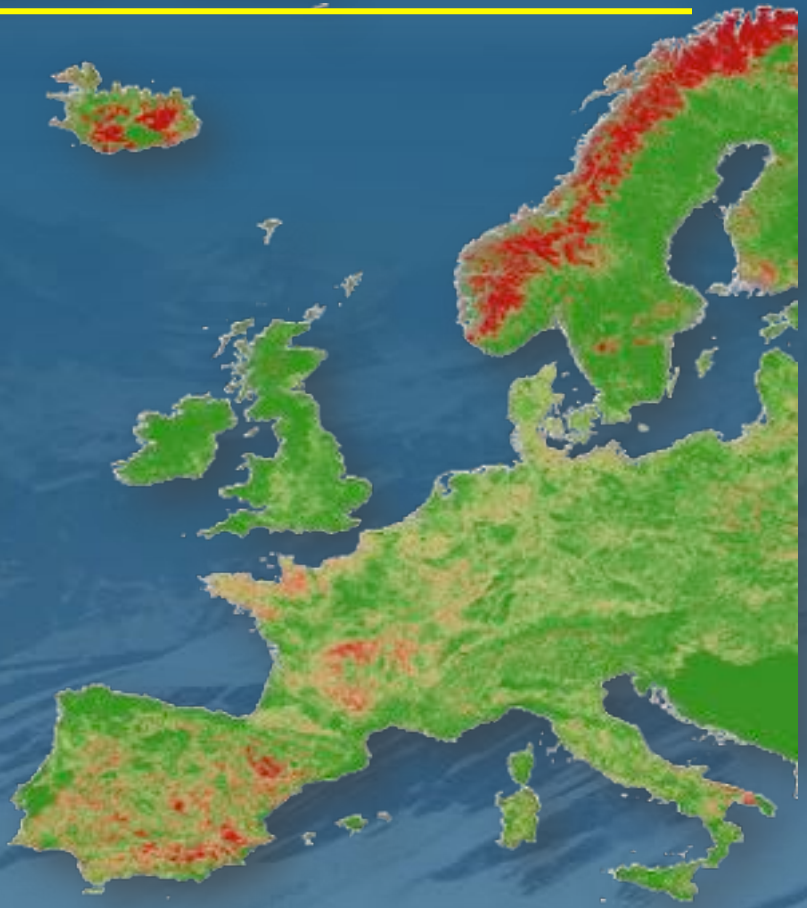
Modello:

Modelli combinati *(scala biogeografica + locale)*

Step 3: Modello combinato

Modello bioclimatico

Modello expert-base

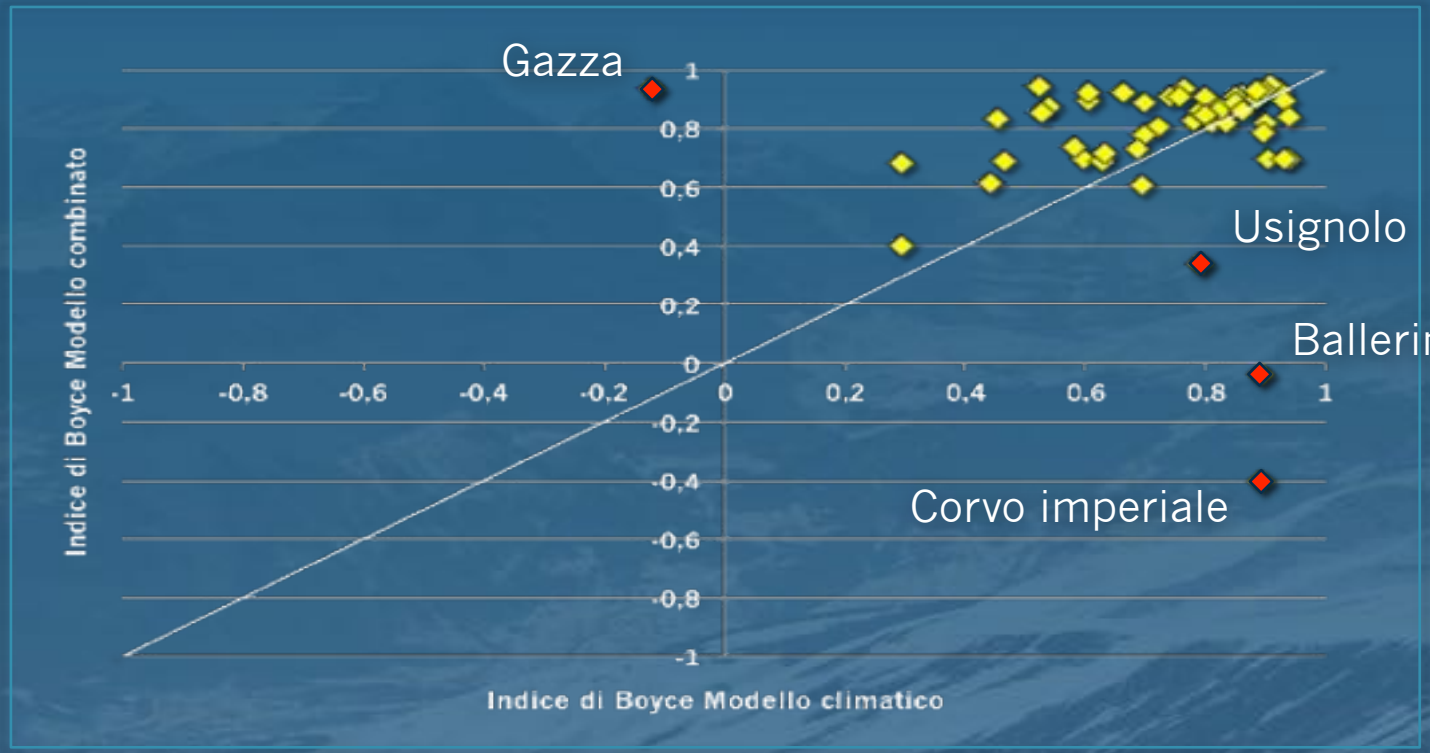


Modello combinato

Validazione dei modelli

Specie	N. punti	Specie	N. punti	Specie	N. punti
Milvus migrans	127	*Troglodytes troglodytes*	1623	*Certhia brachydactyla*	301
Buteo buteo	554	*Turdus merula*	3867	*Oriolus oriolus*	551
Falco tinnunculus	553	*Turdus pilaris*	64	*Lanius collurio*	552
Coturnix coturnix	275	*Sylvia atricapilla*	4317	*Garrulus glandarius*	1226
Columba palumbus	624	*Sylvia communis*	311	*Pica pica*	1598
Streptopelia turtur	1402	*Sylvia melanocephala*	1094	*Corvus monedula*	224
Cuculus canorus	1806	*Muscicapa striata*	240	*Corvus cornix*	2951
Apus apus	2291	*Erithacus rubecula*	1516	*Corvus corax*	115
Upupa epops	615	*Luscinia megarhynchos*	1920	*Sturnus vulgaris*	1460
Jynx torquilla	303	*Phoenicurus ochruros*	375	*Sturnus unicolor*	137
Dendrocopos major	525	*Phoenicurus phoenicurus*	273	*Fringilla coelebs*	3171
Galerida cristata	849	*Saxicola torquatus*	936	*Carduelis chloris*	1551
Lullula arborea	290	*Oenanthe oenanthe*	191	*Carduelis carduelis*	2544
Alauda arvensis	1052	*Aegithalos caudatus*	390	*Carduelis cannabina*	569
Hirundo rustica	2338	*Poecile palustris*	203	*Serinus serinus*	1805
Delichon urbicum	1428	*Periparus ater*	689	*Emberiza cirlus*	1198
Motacilla alba	636	*Parus major*	2291	*Emberiza cia*	89
Motacilla cinerea	186	*Cyanistes caeruleus*	1342	*Miliaria calandra*	874
Anthus trivialis	268	*Sitta europaea*	410		

Risultati



79% dei modelli combinati sono migliori di quelli solo climatici

Sviluppi futuri

- Combinare l'approccio multiscala con scenari futuri di clima e utilizzo del suolo;
- Incorporare interazioni biotiche tra le specie;
- Utilizzare distanze di dispersal.

Obiettivo finale

Modelli più accurati e robusti della risposta delle specie alle sfide ambientali del futuro

Grazie per l’attenzione

Photo: Paul Cools