Distribution de l'habitat des nichées du Tétras Lyre dans les Alpes grâce aux données de télédétection

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CONTEXT

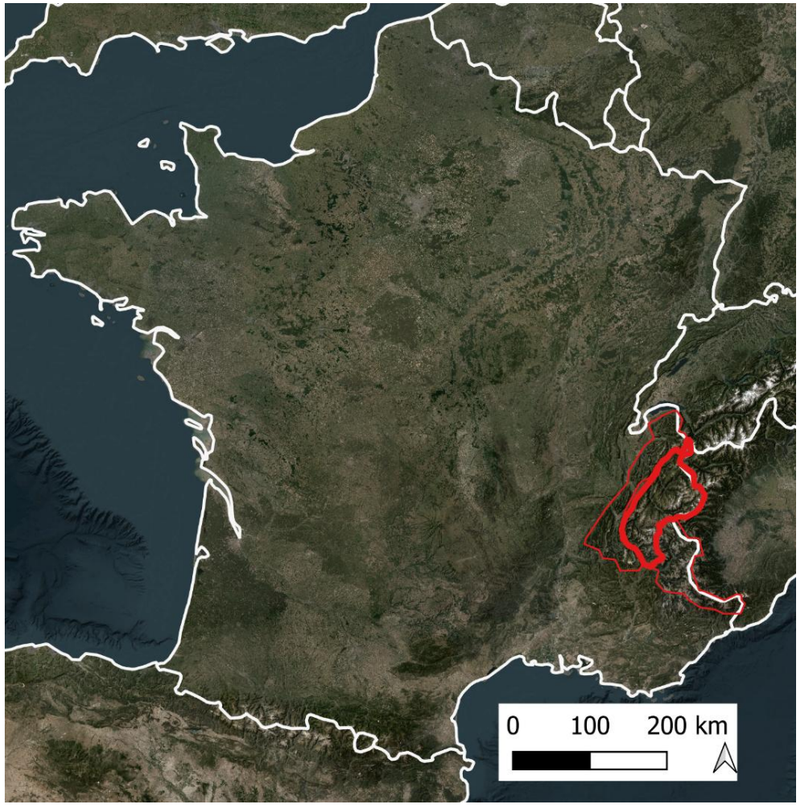
- **Vulnerable species at regional scale**:
- Main threats: degradation of environments,
- Habitat closure, tourist infrastructures
- Hunting management (quotas)
- Model species revealing evolutions of subalpine environments

- **Food availability is one of the main drivers for habitat suitability**:
- Winter: wooded area (pine needles, buds...)
- Summer: importance of ericaceous heaths (berries, flowers, young shoots...)

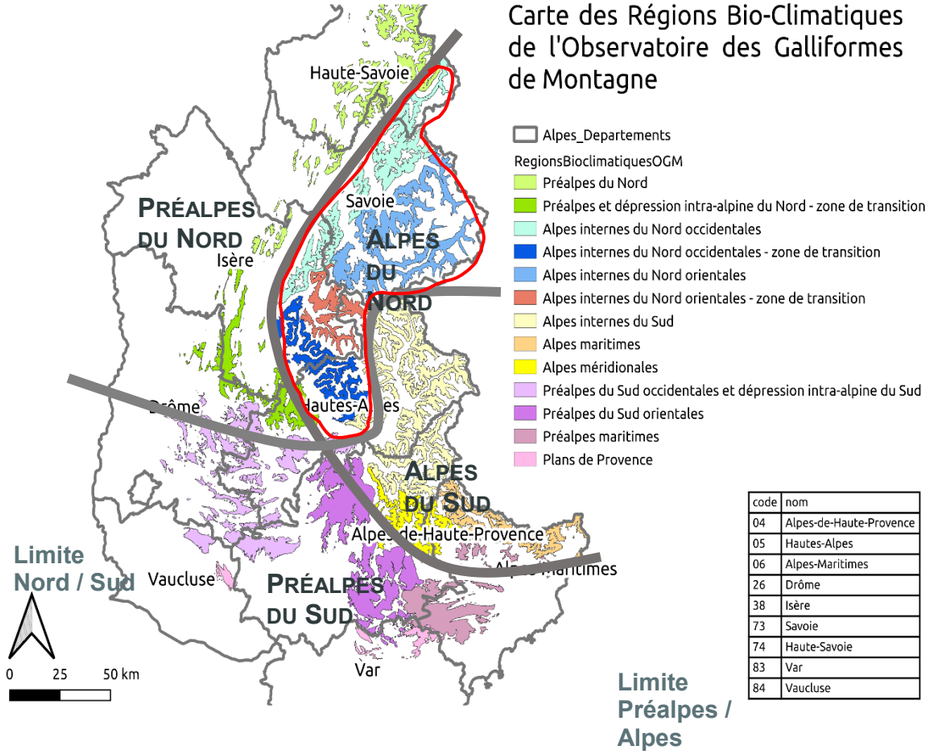
OBJECTIVES

- Improving knowledge of the suitability of black grouse brood habitat.
- Combining Remote Sensing (RS) and modelling to produce an operational map that can be utilised by wildlife managers to guide future sampling observation campaigns

CHALLENGE



The challenge of this project is to map the breeding habitats of the black grouse at the regional scale of the French Alps



- Priority area: **Northern Inner Alps** (2743 km²)
- Altitudinal range: **1600-2400m**
- Studied year: **2020**

Method

I. Production of BHS Predictive Variables from remote sensing data

Meter-scale resolution images

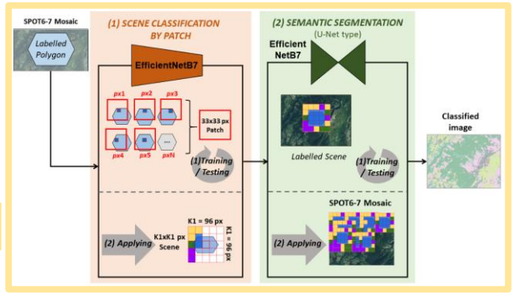
Topography

Multispectral Time Series

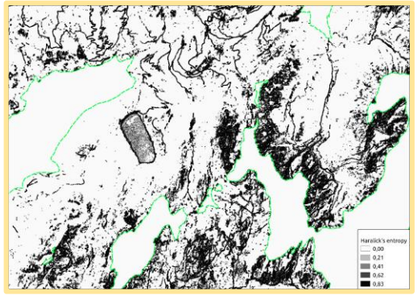
Composition | *Structure* | *Functioning*

Landscape features extraction

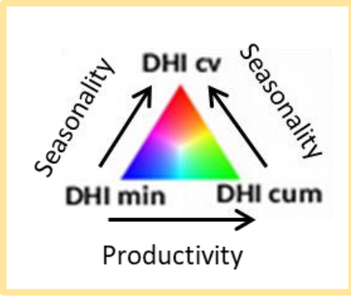
CNN Deep Learning (composition)



Texture, Haralick (structure)



DHI (fonctionnement)



Habitat Suitability Predictor Variables

II. SDM performing, predictive variable assessment and BHS mapping

Species Distribution Model

Brood count

1453 obs. (2015-2021)

Predictor Variable assessment

Brood Habitat Suitability Map

- Cross-validation: 2 runs with random allocation of 80% training / 20% testing
- 10 sets of 4359 pseudo-absences (3 x number of observations) from a pool of 43590 random PA

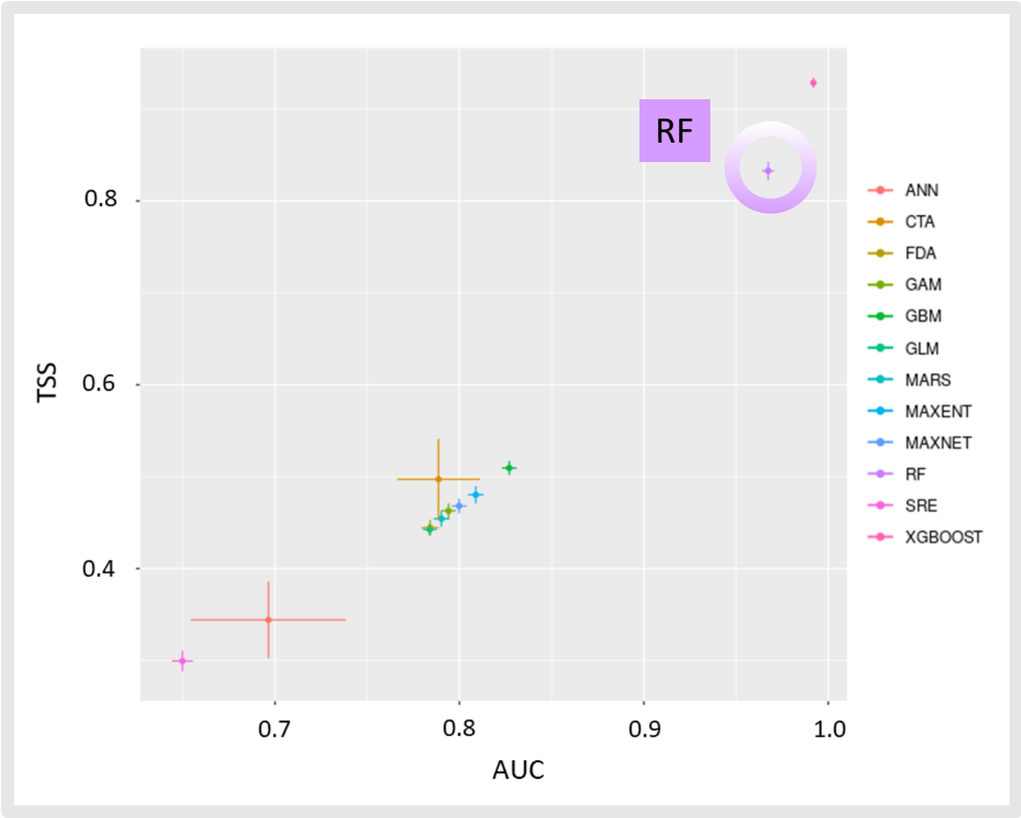
8 Landscape variables

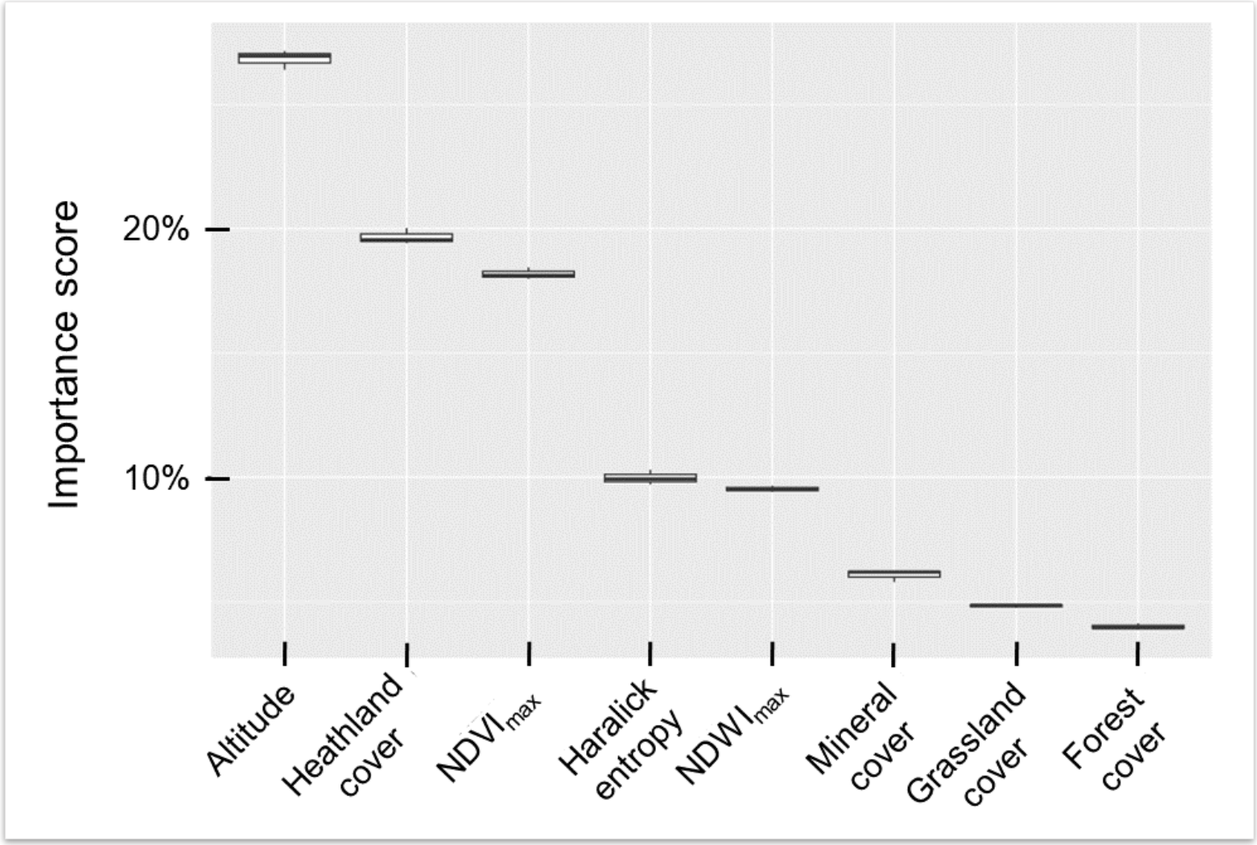
Landscape dimension	Landscape variable	Description	Processing	Type of source images	Source
Composition	Mineral_Rate	Mineral surface rate per 100m^2	DL classification	Very High Spatial Resolution	SPOT 6&7
	Grassland_Rate	Grassland surface rate per 100m^2	DL classification	Very High Spatial Resolution	SPOT 6&7
	Heath_Rate	Ericaceous heath surface rate per 100m^2	DL classification	Very High Spatial Resolution	SPOT 6&7
	Forest_Rate	Forest surface rate per 100m^2	DL classification	Very High Spatial Resolution	SPOT 6&7
Structure	Entropy	Haralick Entropy	Texture analysis	Very High Spatial Resolution	SPOT 6&7
	Altitude	Altitude (m)	DEM	Airborne LIDAR / Aerial photography	IGN database
Functioning	$NDVI_{max}$	Maximum annual NDVI (DHI)	Time series analysis	Multispectral	Temporal series Sentinel 2
	$NDWI_{max}$	Maximum annual NDWI (DHI)	Time series analysis	Multispectral	Temporal series Sentinel 2

RESULTS

Models performances scores

(Biomod 2)



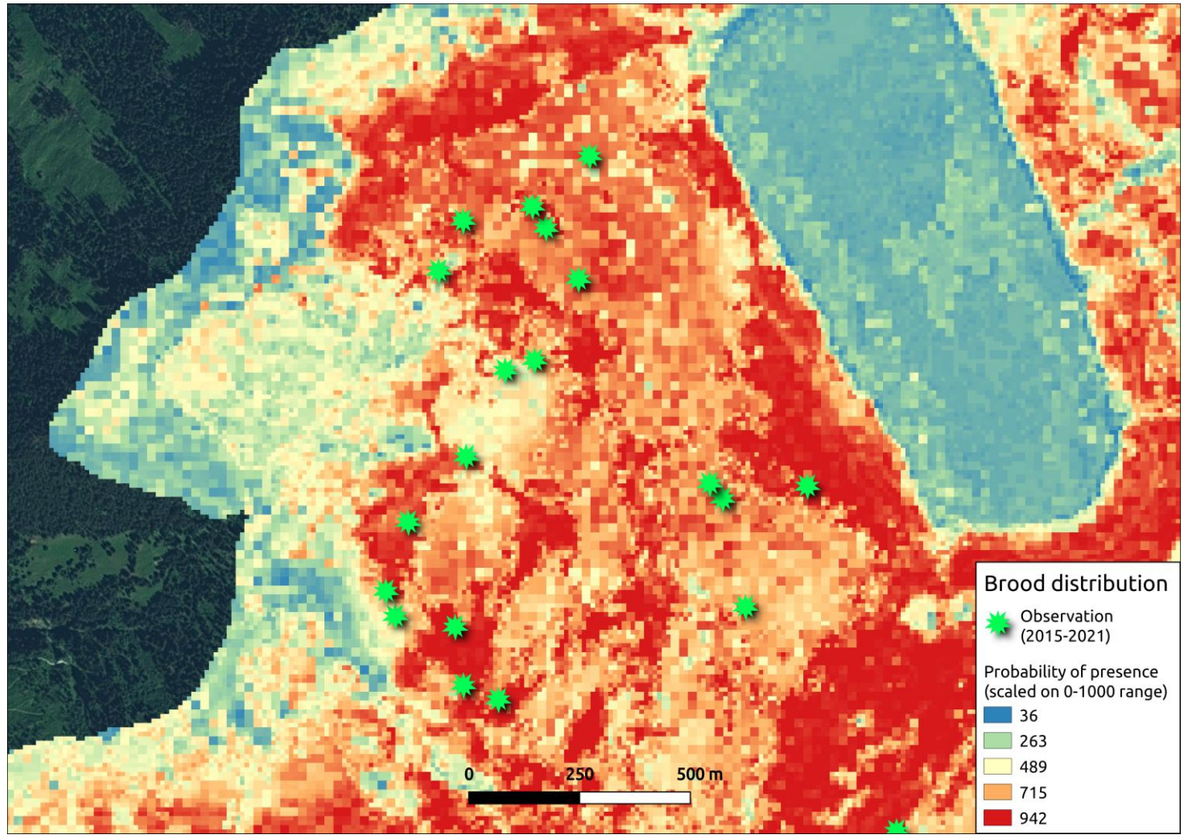


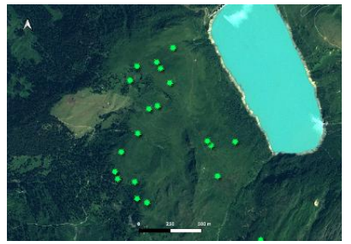
Relative importance of the landscape variables after RF over an ensemble model

(New run with updated number of PA: 3 sets of 1453 random PA (number of PA = number of observations)

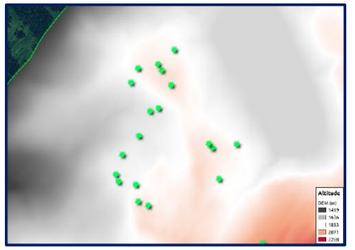
Distribution Map

Lac de la Girote

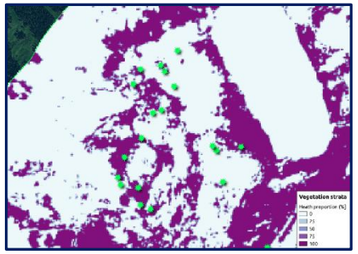




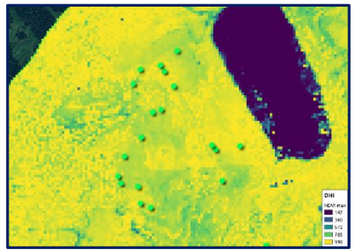
True colors



Altitude



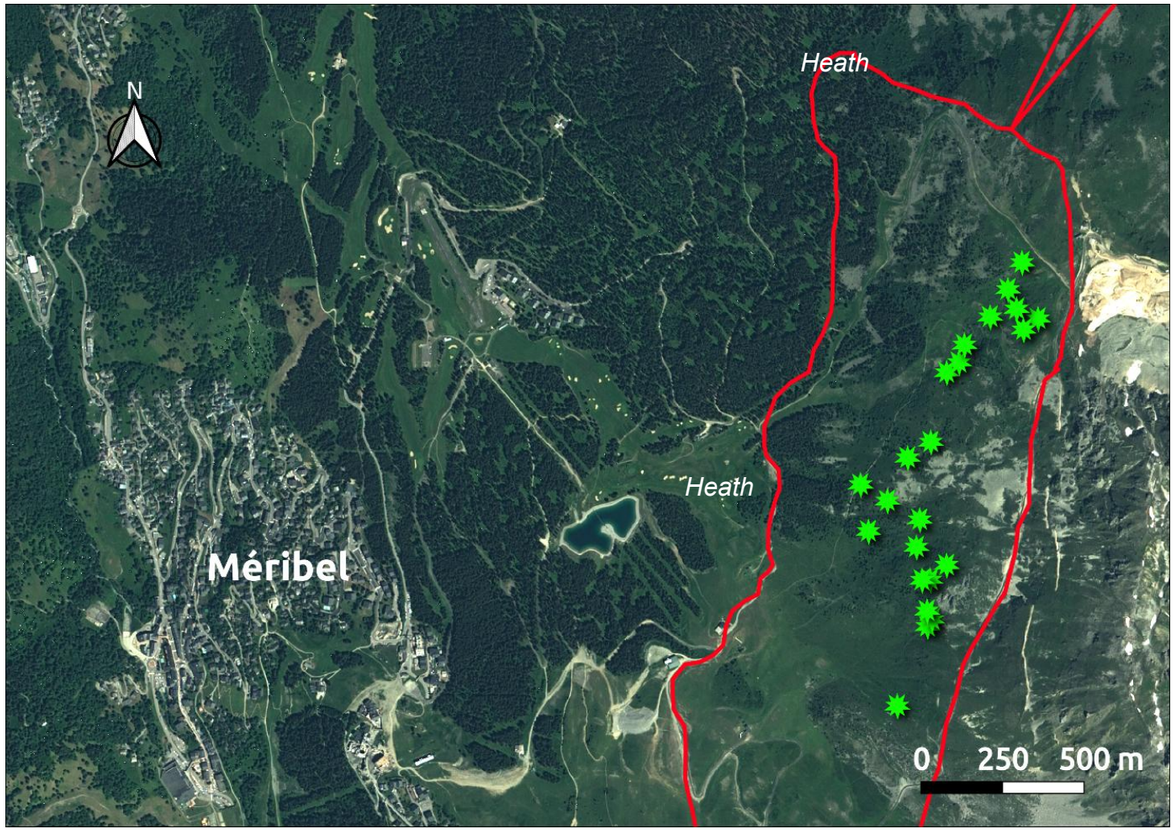
Heath rate (%)



$NDVI_{Max}$

- Distribution map is coherent with known hot spots of black grouse broods
- Very clear influence of heathland

Distribution Map



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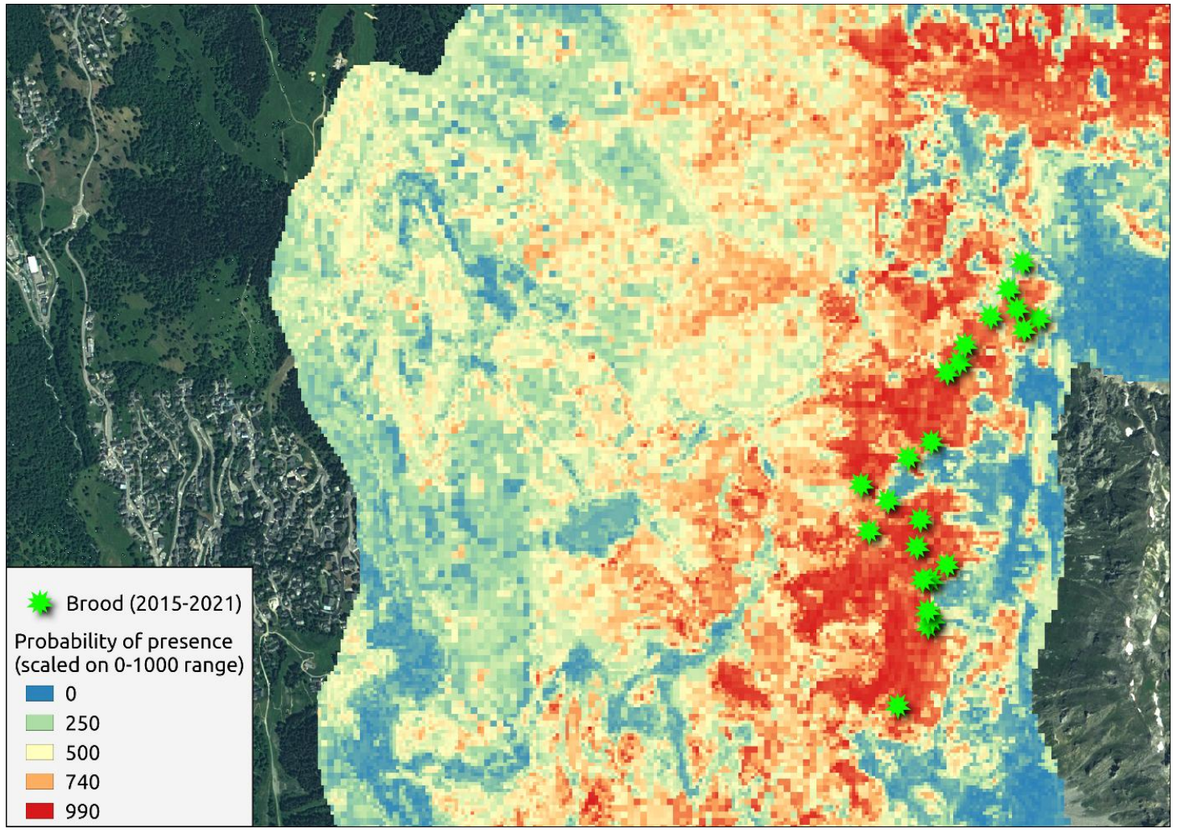

Probability of brood presence

Conclusion

- **Three landscape dimensions (composition, structure, functioning) are essential to characterising species habitat**

- **RS data combined with modelling is well suited to mapping the potential presence of black grouse broods**

- **Ericaceous heathland cover** is one of the main variables explaining the distribution of broods in the French Alps, **confirming the importance of this vegetation layer** in describing female black grouse brood habitat selection.

- **NDVI$_{max}$** could be spatially (and temporally) related to **a peak in food abundance or quality**, which is known to be one of the main determinants of female selection of brood-rearing habitat, with suitable vegetation cover

- **Altitude** is an important factor: likely influence of the presence of **the upper tree line and transition zones** between forest and grassland

Perspectives & Besoins

- Test other variables derived of DEM (*e.g.* total insolation)
- Extent to other bioregions: Northern pre-Alps, Southern Alps
- Refine vegetation layers: *e.g.* include "medium" heathlands / Larch woodland (South) ?

- Ressources :

Article **: *Assessing habitat suitability for black grouse broods at the bioregional scale. Wildlife Biology. Revision***

Colloque ***: Modeling the breeding habitat of the Black Grouse from remote sensing data (hal-04589682v1***)
Colloque ***: Modeling black grouse brood habitat in the French Alps using remote sensing***

Rapport **: *Cartographie de l'habitat de reproduction du tétras-lyre (Lyrurus tetrix) dans les Alpes françaises* (hal-04469226v2)**
Rapport **: *Guide de photo-interprétation des classes de végétation dans des zones d'habitat du tétras-lyre* (hal-04456793v2)**
Poster **: *Comprehensive regional assessment of brood habitat suitability for Alpine black grouse (Lyrurus tetrix)* (hal-04929144v1)**
Scripts **: *SDM of black grouse broods in the French Alps,* https://doi.org/10.57745/7N1KMB, Recherche Data Gouv**

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