Coherent predictand areas for spatially coherent precipitation downscaling

Sabine Radanovics[1], Jean-Philippe Vidal[1], Eric Sauquet[1], Aurélien Ben Daoud[2], Guillaume Bontron[2]

[1]Irstea, UR HHLY, [2]CNR (Compagnie Nationale de Rhône)

11 April 2013

To better reflect its missions Cemagref becomes Irstea.

www.irstea.fr

Compagnie Nationale du Rhône
L'ENERGIE A L'ETAT PUR

Outline

Motivation

Local skill vs. spatial coherence

- Maximise skill on the local scale
- Maximise the areas that use the same parameters for downscaling to improve spatial coherence

Questions

- What are the optimum predictor domains for each location in France?
- How to aggregate predictand areas without loosing skill?

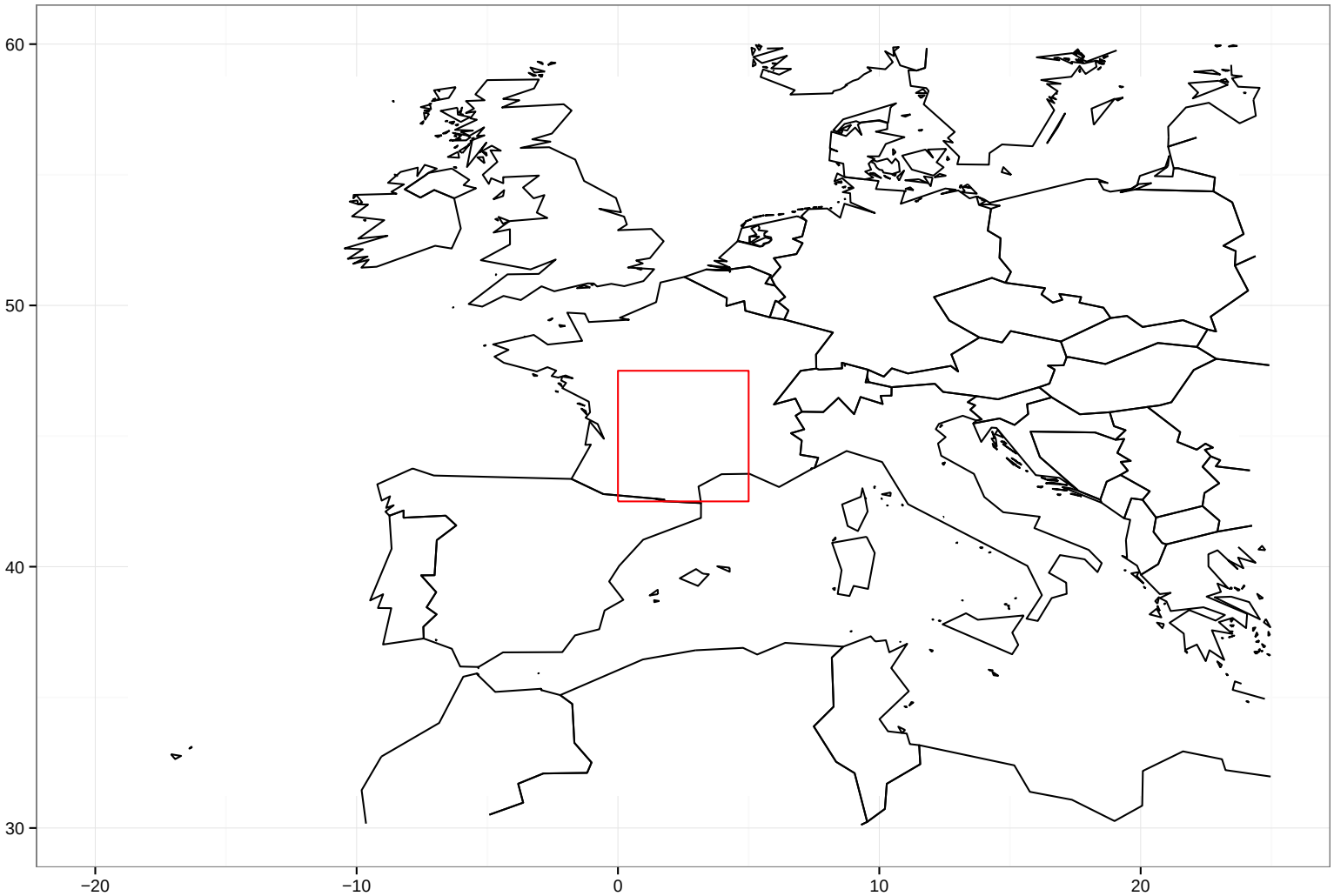
Analogue method

Predictor ERA-40 (Uppala et al., 2005)	Pressure level [hPa]	Similarity citerion	Number of analogues
Temperature	925, 600	Euclidean distance	2000
Geopotential	1000, 500	Teweles and Wobus shape criteria	170
Vertical velocity	850	Euclidean distance	70
Humidity (TCW*rh)	850	Euclidean distance	25

Predictand	Safran (French near surface reanalysis, Vidal et al. (2010))
daily precipitation	608 climatologically homogeneous zones in France

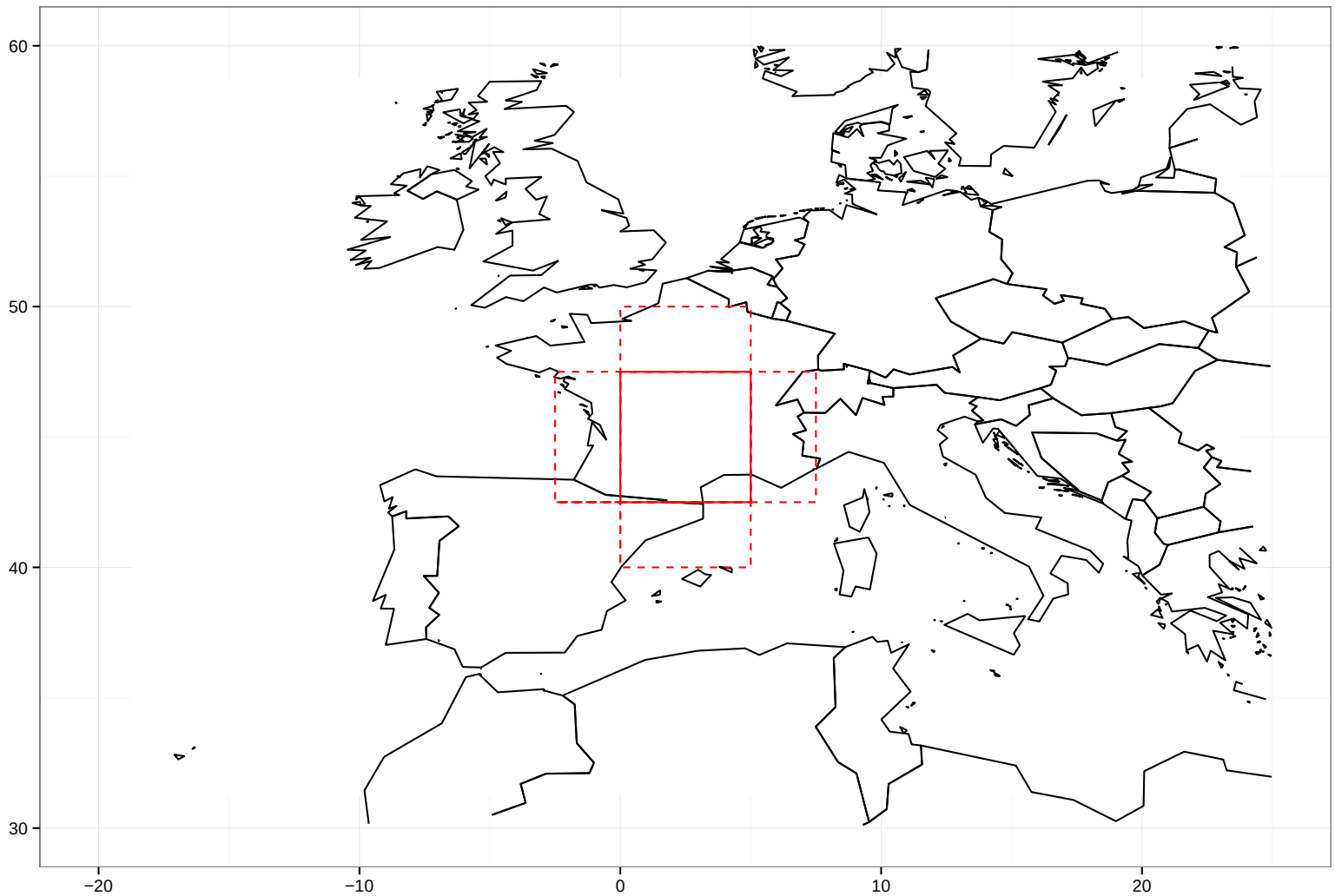
Growing rectangular domains algorithm

Keeping the 5 best geopotential predictor domains



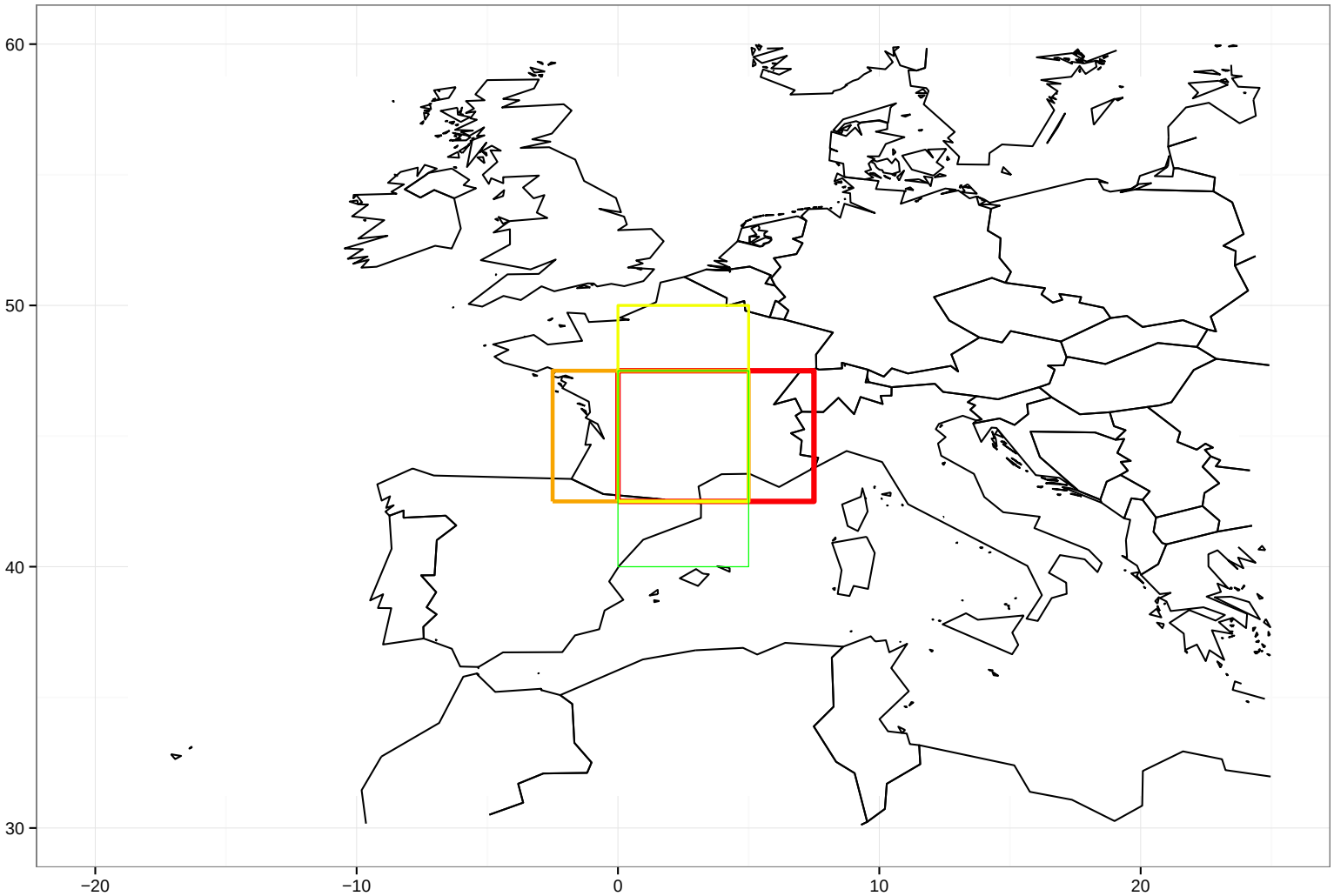
Growing rectangular domains algorithm

Keeping the 5 best geopotential predictor domains



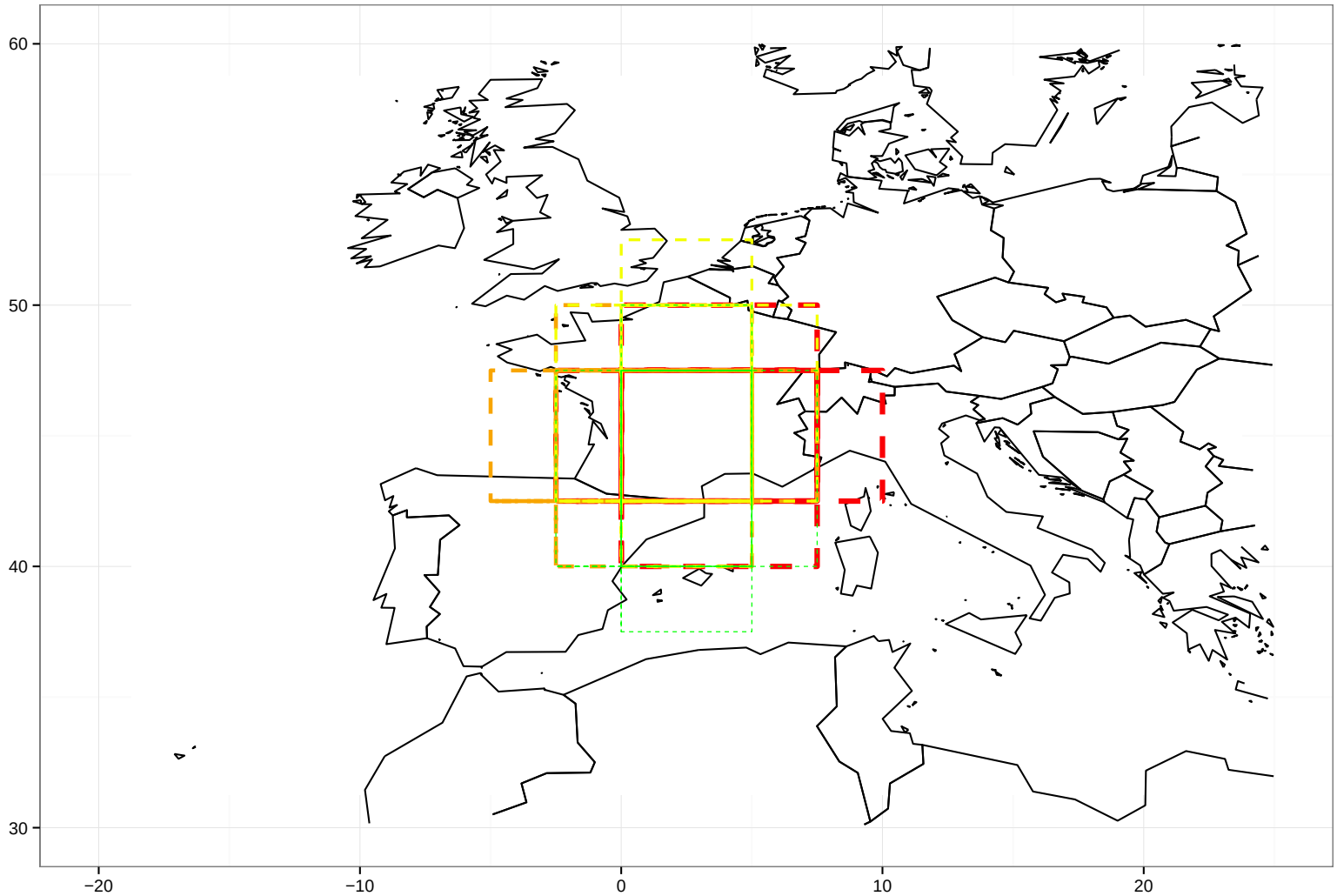
Growing rectangular domains algorithm

Keeping the 5 best geopotential predictor domains



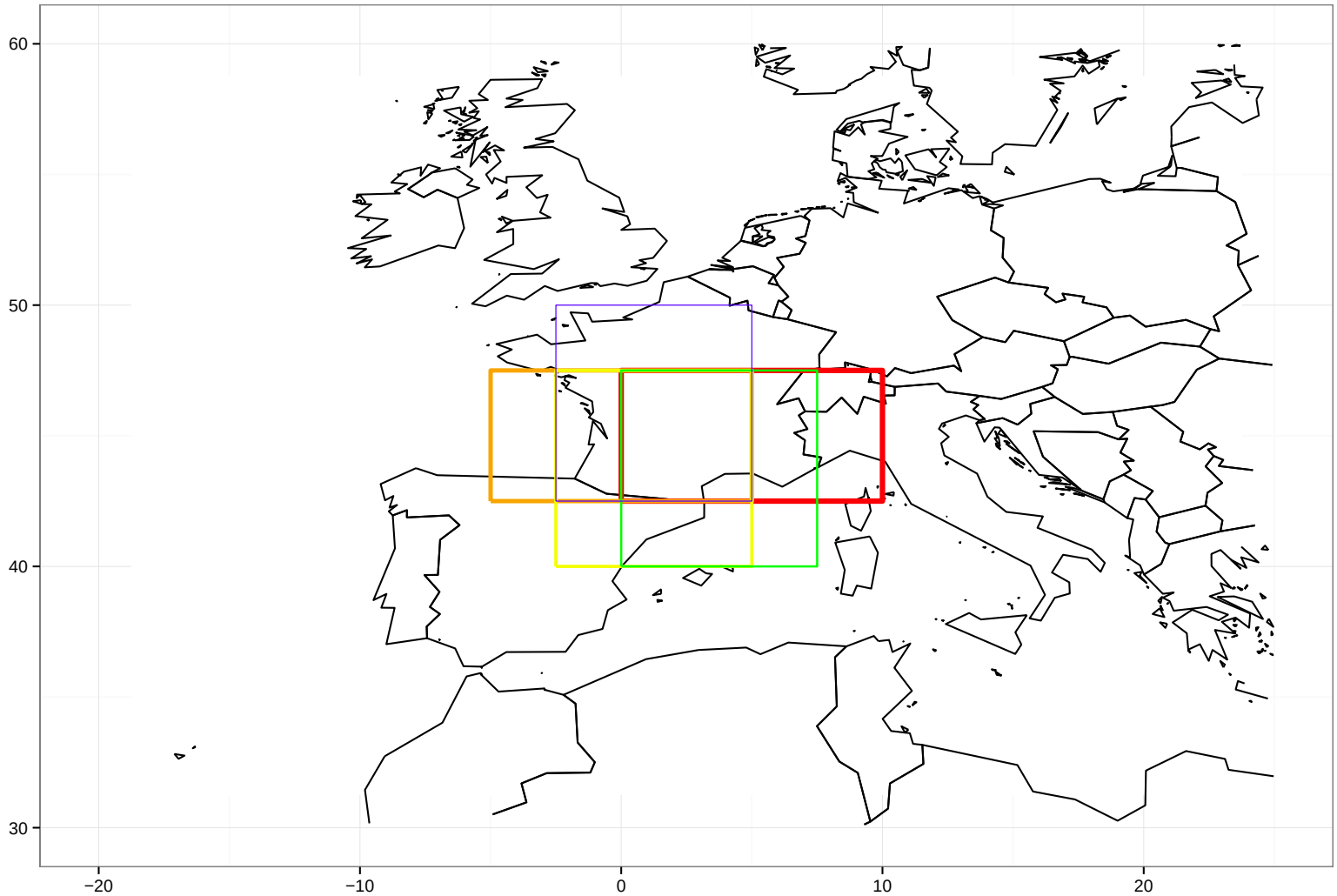
Growing rectangular domains algorithm

Keeping the 5 best geopotential predictor domains



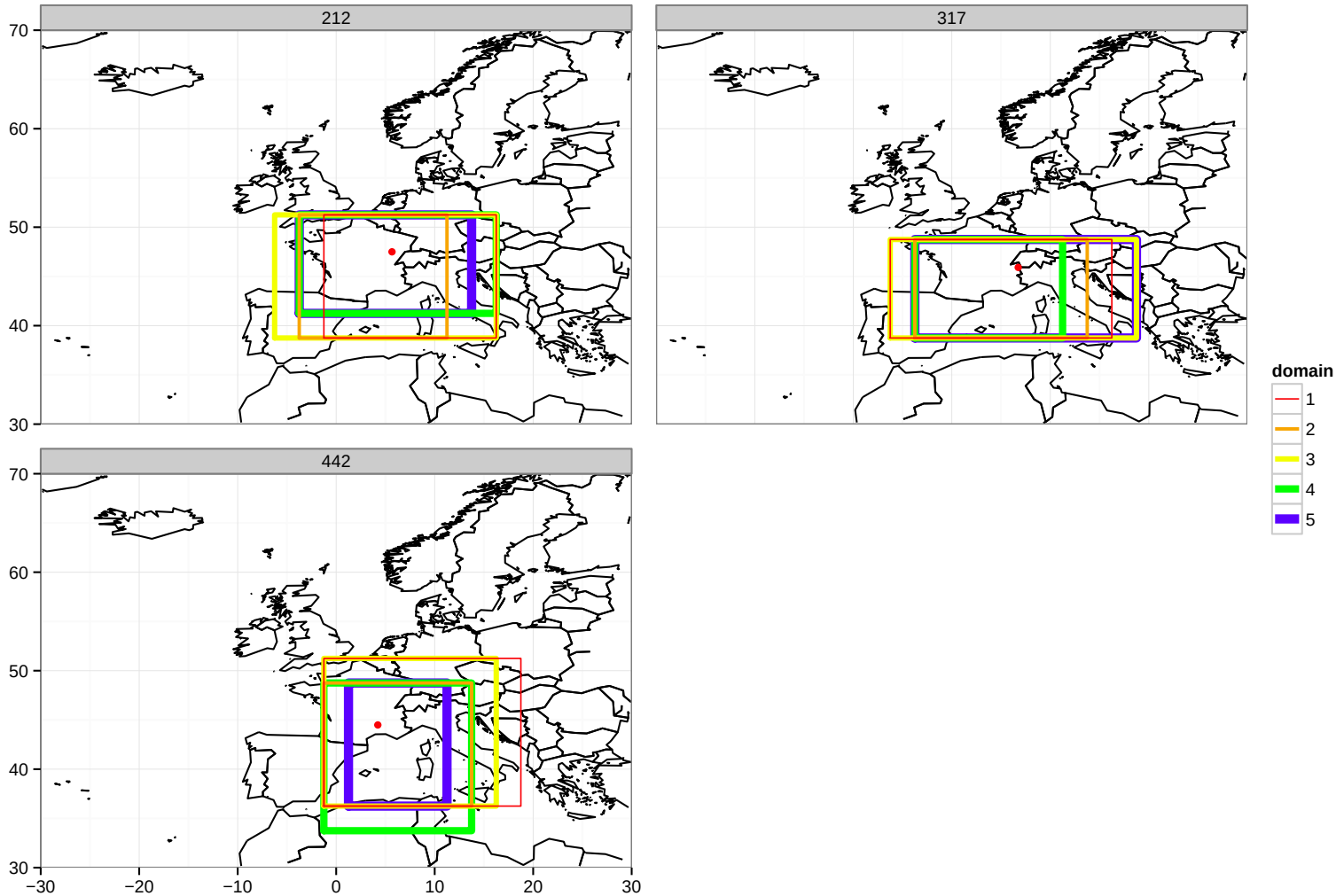
Growing rectangular domains algorithm

Keeping the 5 best geopotential predictor domains



Near optimal domains

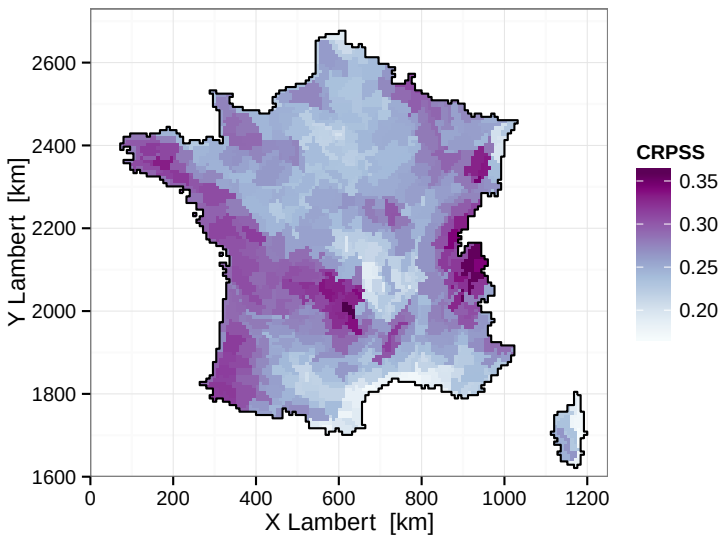
3 zones belonging to the Rhône river basin



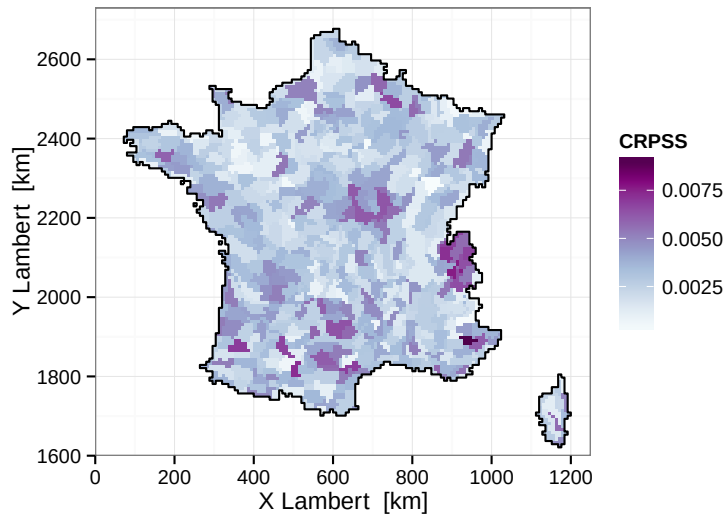
- 5 domains for each zone
- different domains for different zones

Downscaling skill - CRPSS

Mean CRPSS

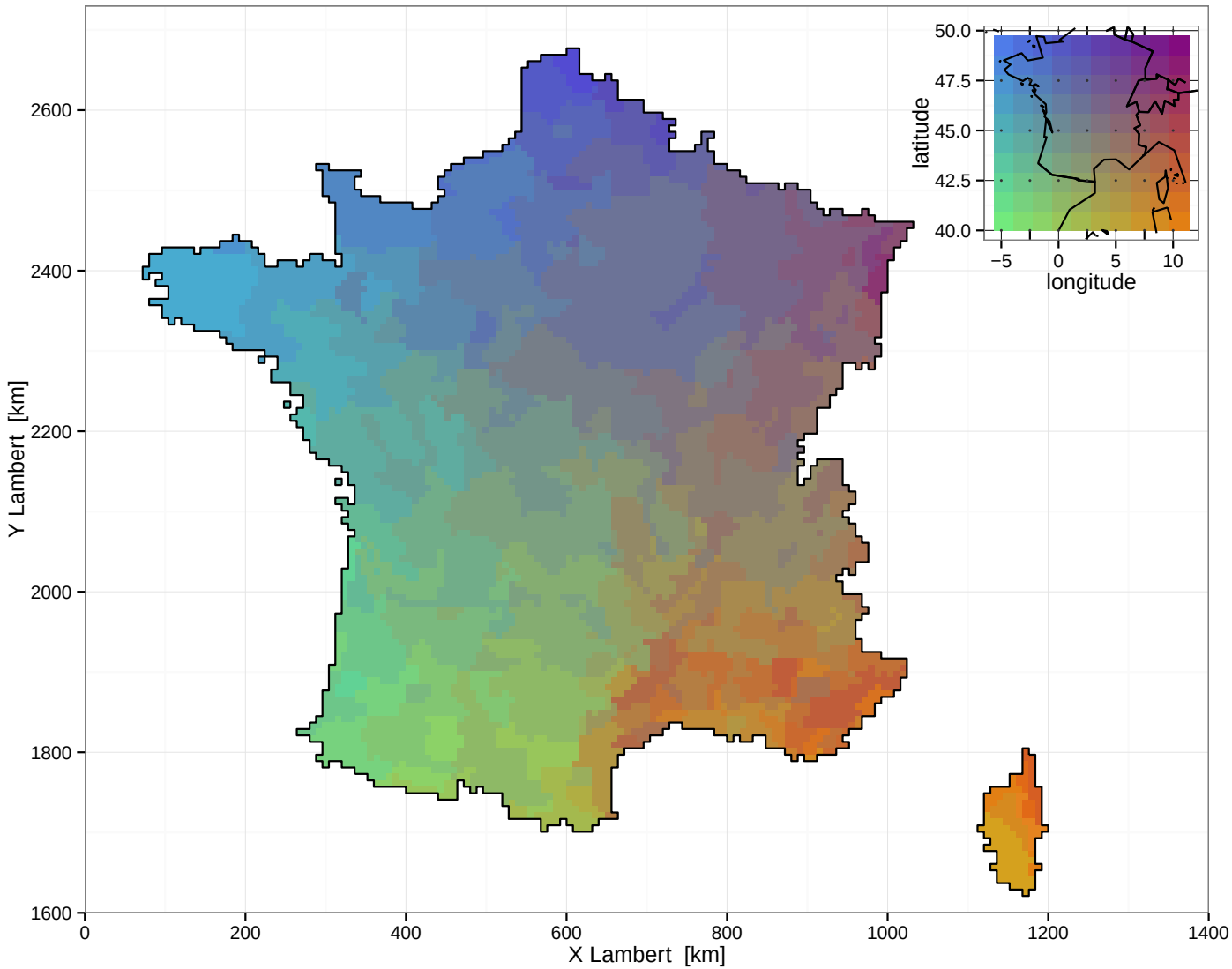


CRPSS difference 1st-5th domain



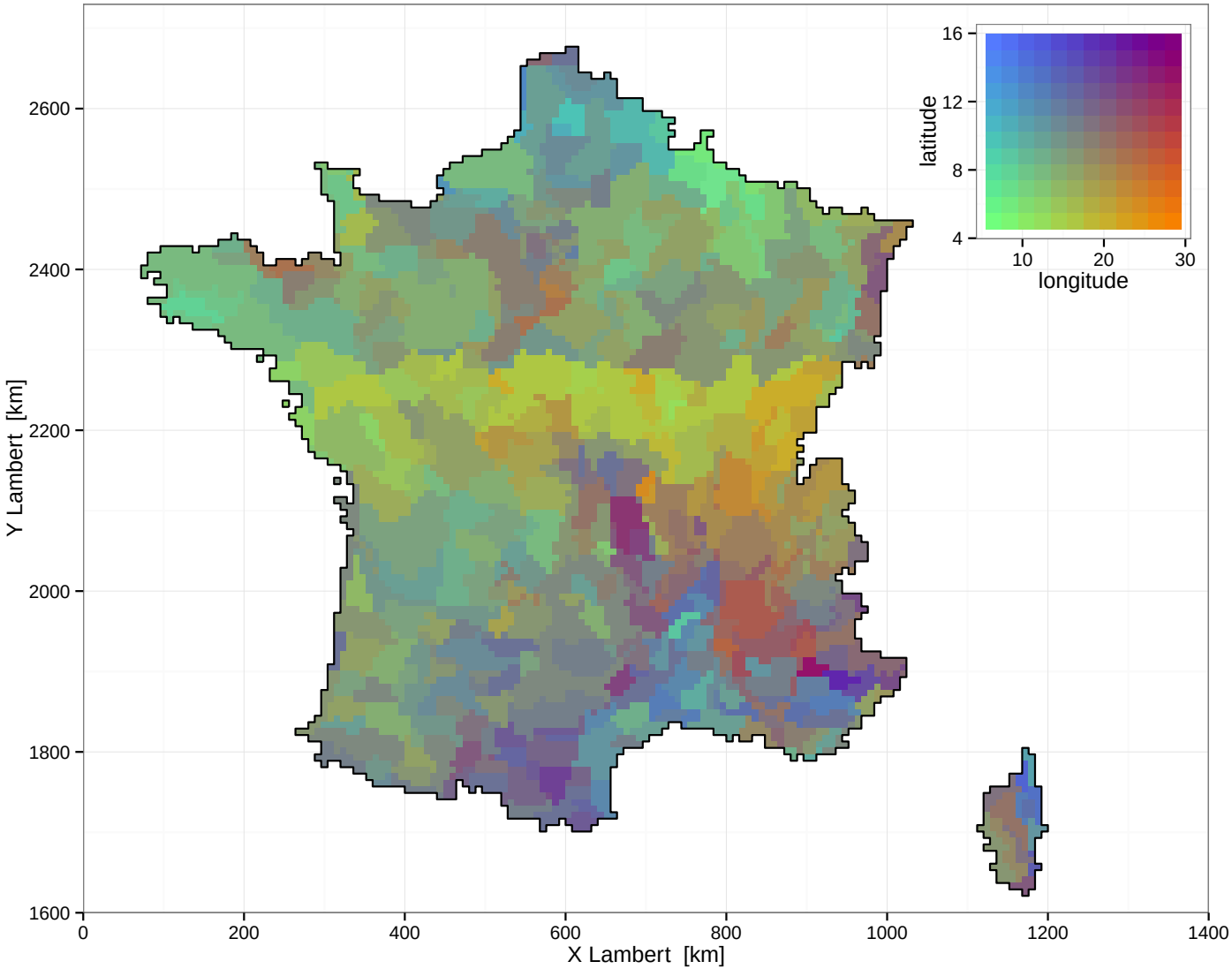
- Skill depends on precipitation regime
- Very small differeces in skill $\rightarrow$ 5 near optimal domains

Mean domain center of near optimum domains



- Centers mainly distributed according to geographical locations
- Differences between windward and lee side of mountain ridges

Mean domain extent of near optimum domains



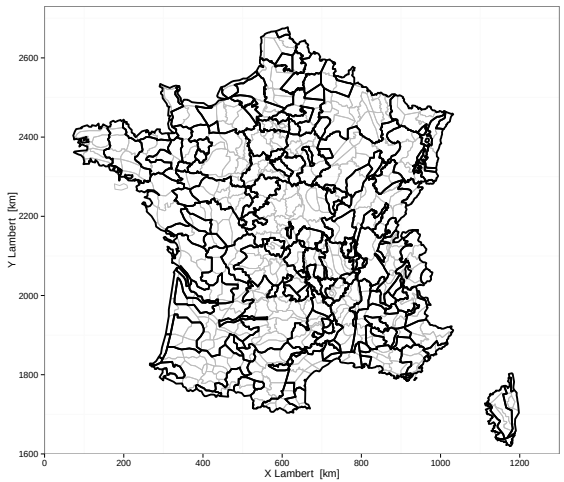
- Larger domains in the south, smaller domains in the north
- Small meridional extent in the center

Aggregate predictand areas by identical optimised domain

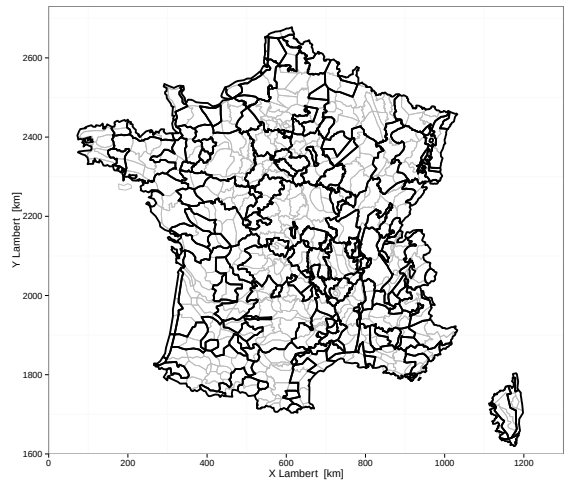
- How far can predictand areas be aggregated into groups that use the same predictor domain without loosing skill?
- Idea: group zones that can use identical predictor domains
- Problem: ties in proximity $\rightarrow$ many possible solutions
- Obtained solution depends on the order of the elements in the input file

Aggregated predictand areas

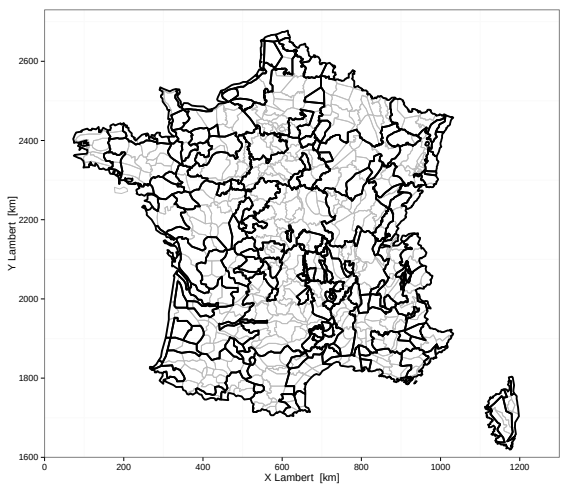
102 groups



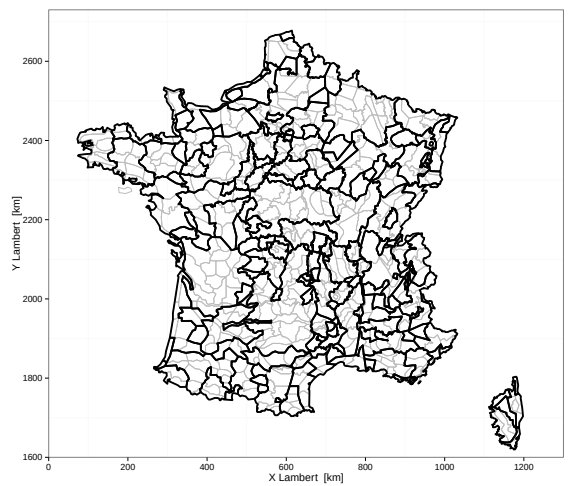
100 groups



120 groups



126 groups



- Possible solutions with different algorithms
- Choice depends on application

Summary

Predictor domains

- 5 near-optimum geopotential predictor domains per zone

Please comment on the article:

- Radanovics, S. et al. (2013). Optimising predictor domains for spatially coherent precipitation downscaling. *Hydrology and Earth System Sciences Discussions*, 10(4):4015-4061.

  http://www.hydrol-earth-syst-sci-discuss.net/10/4015/2013

Aggregated predictand areas

- Solutions with 100-126 groups found
- Choice of solution depends on application

Outlook

- Quantify the skill loss if a common predictor domain for a whole river basin is used instead of optimised predictor domains for subregions.

References

Ben Daoud, A. (2010). *Améliorations et développements d'une méthode de prévision probabiliste des pluies par analogie. Application à la prévision hydrologique sur les grands bassins fluviaux de la Saône et de la Seine.* Thèse de doctorat, Université Joseph Fourier, Grenoble. (in French).

Fernández, A. and Gómez, S. (2008). Solving non-uniqueness in agglomerative hierarchical clustering using multidendrograms. *Journal of Classification*, 25:43–65.

Radanovics, S., Vidal, J.-P., Sauquet, E., Ben Daoud, A., and Bontron, G. (2013). Optimising predictor domains for spatially coherent precipitation downscaling. *Hydrology and Earth System Sciences Discussions*, 10(4):4015–4061.

Uppala, S. M. et al. (2005). The era-40 re-analysis. *Quarterly Journal of the Royal Meteorological Society*, 131(612):2961–3012.

Vidal, J.-P., Martin, E., Franchistéguy, L., Baillon, M., and Soubeyroux, J.-M. (2010). A 50-year high-resolution atmospheric reanalysis over france with the safran system. *International Journal of Climatology*, 30(11):1627–1644.