Locating organic carbon deposition and degradation hotspots on continental margins

Conference Poster

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1 Introduction

Continental margins are important sites of organic carbon (OC) storage since they receive high OC content from primary productivity in coastal marine systems as well as OC delivered from land [1]. Although these areas store higher OC content than the open ocean's seafloor, continental margins are highly heterogenous, where certain margins act as sites of preferential OC deposition and storage, while limited OC is accumulated in others [2]. The processes that drive this heterogeneity can be resolved using the radiocarbon age of OC to distinguish areas of new and old OC deposition.

Aims

Delineate continental margins that act as hotspots of OC deposition and the factors that drive this spatial distribution.

Locate continental margins that receive young OC (^{14}C enriched) and aged OC (^{14}C depleted) and the factors that drive this distribution.

2 Methods

1. The Modern Ocean Sedimentary Archive and Inventory of Carbon (MOSAIC) [3] is continuously being expanded and currently includes >12000 datapoints of OC and >2000 datapoints of its radiocarbon content in surface sediment (Fig. 1).

2. Datapoints from continental margins were extracted using the shelf and slope from the Geomorphology Atlas [4].
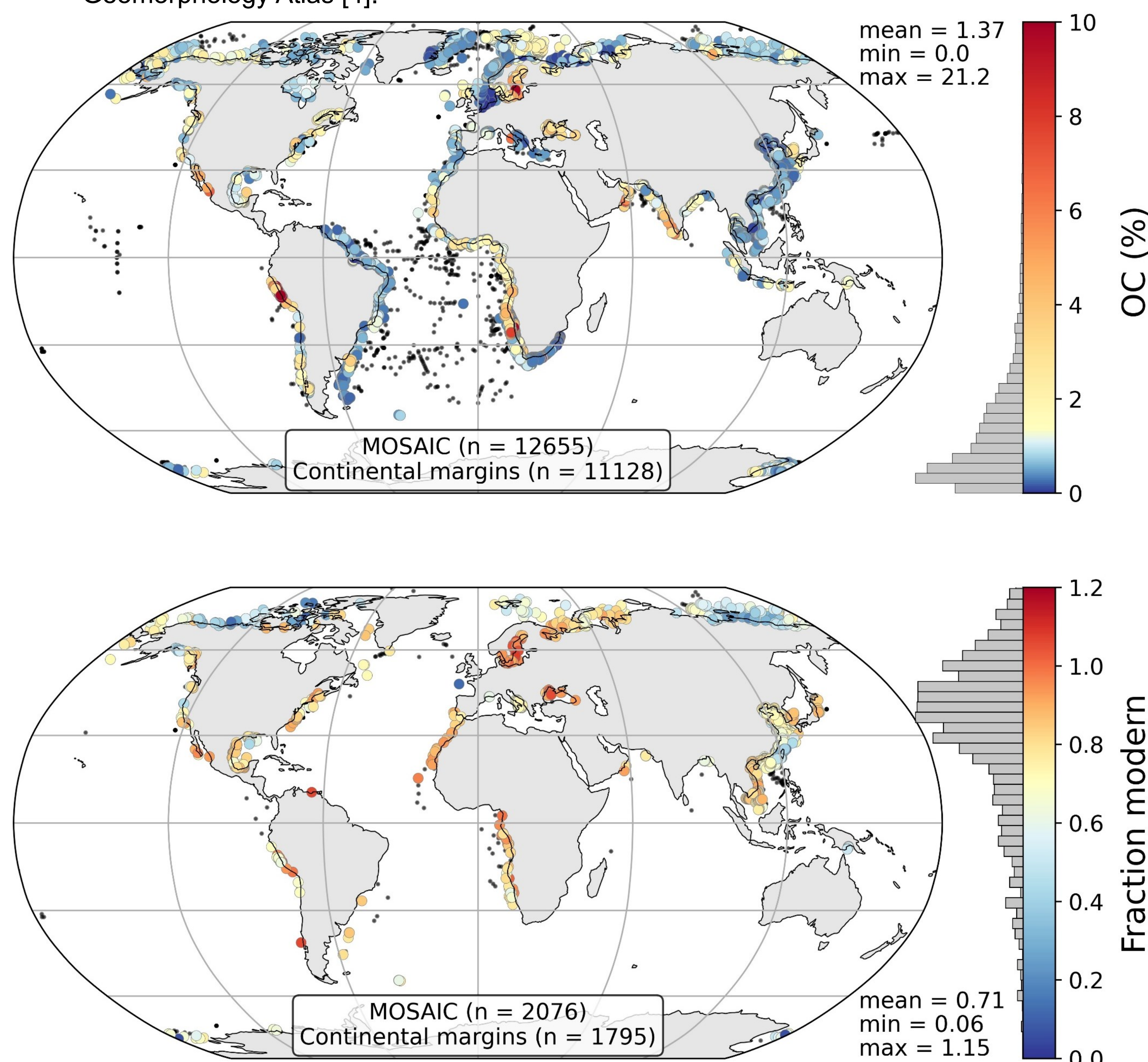

Fig. 1. Spatial distribution of OC and ^{14}C (expressed as fraction modern) in surficial sediments of continental margins (colored dots). Black datapoints indicate data in MOSAIC.

2. To determine whether a site has spatially higher/lower OC and enriched/depleted ^{14}C, the Getis-Ord Gi* [5] was calculated using a buffer distance of 130 km.

3. The output from the OC and ^{14}C Getis-Ord Gi* were combined:

   a. Sites with high OC and enriched ^{14}C: high and young OC
   b. Sites with high OC and depleted ^{14}C: high and old OC
   c. Sites with low OC and enriched ^{14}C: low and young OC,
   d. Sites with low OC and depleted ^{14}C: low and old OC.

4. A Random Forest Classifier [6] was used to identify the features (Table 1) that cause high or low OC content (Fig. 2), young or old OC (Fig. 3), and the combination of both OC and ^{14}C spatial analyses (Fig. 4).

Table 1. Example features used in the Random Forest Classifier

Chemical features	Physical features
Bottom oxygen	Depth
Nutrient concentrations	Distance from shore
Temperature and salinity	Latitude

3 Results and Discussion

Hotspots of OC deposition:
- High OC in upwelling (high nutrient) and in high-latitude (permafrost thawing) margins.
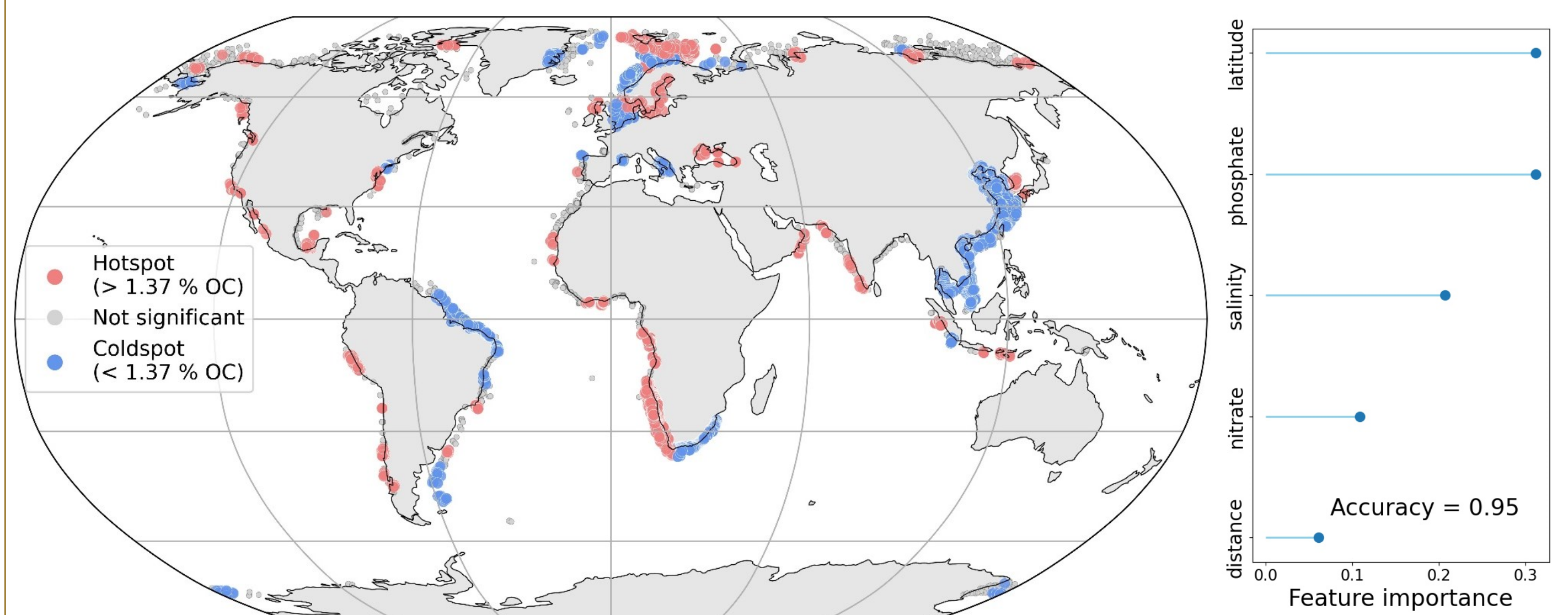- Low OC offshore rivers and in broad margins with lateral transport and degradation.

Fig. 2. Spatial distribution of OC hotspots and coldspots, and the most influential features.

Hotspots of ^{14}C deposition:
- Enriched ^{14}C (young OC) in upwelling margins with low oxygen that limit its ageing.
- Distance from coast controls oxygen exposure time, regulating ageing of OC.
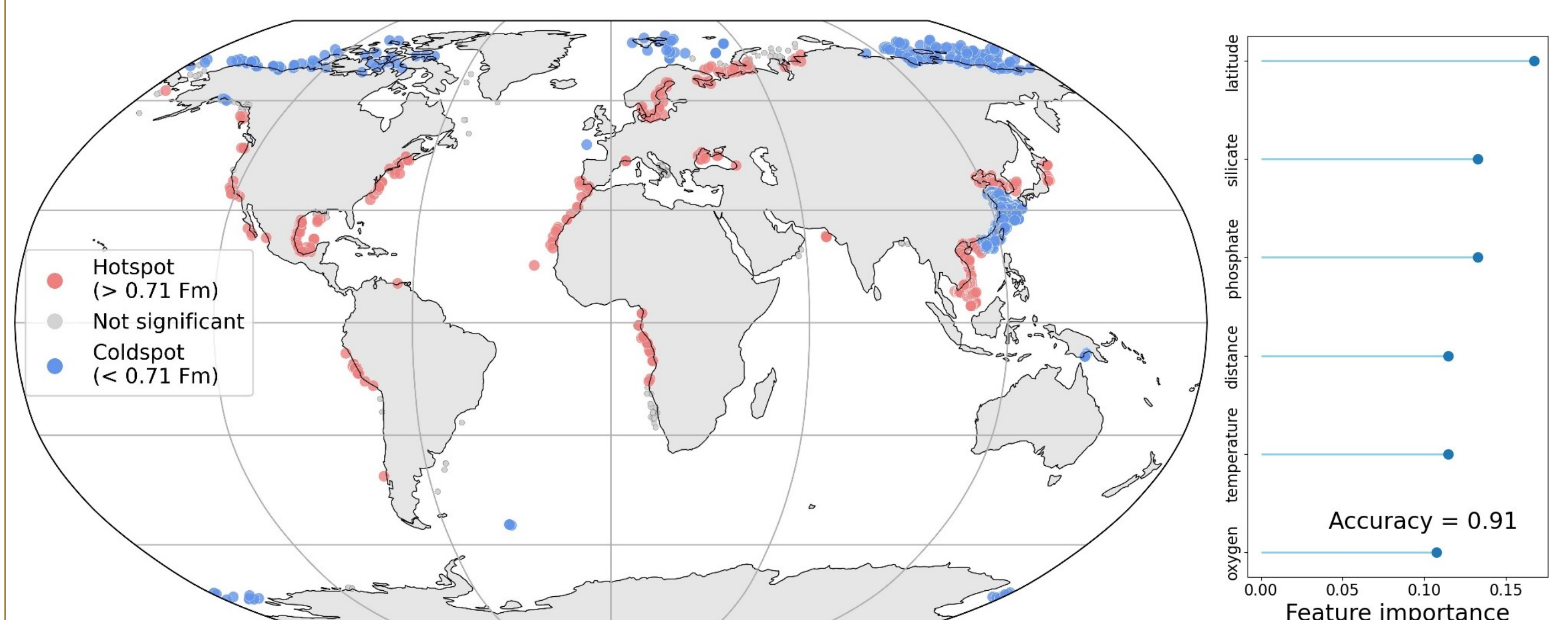- Depleted ^{14}C occur in high-latitude margins that receive pre-aged OC from permafrost.

Fig. 3. Spatial distribution of ^{14}C hotspots and coldspots, and the most influential features.

Hotspots of OC and ^{14}C deposition:
- High young OC in upwelling margins with low oxygen that limit degradation and ageing.
- High old OC in high-latitude margins that receive high OC but pre-aged from permafrost.
- Low young OC in narrow continental margins with limited ageing due to lateral transport.
- Low old OC in broad continental shelves that promote its ageing and degradation.
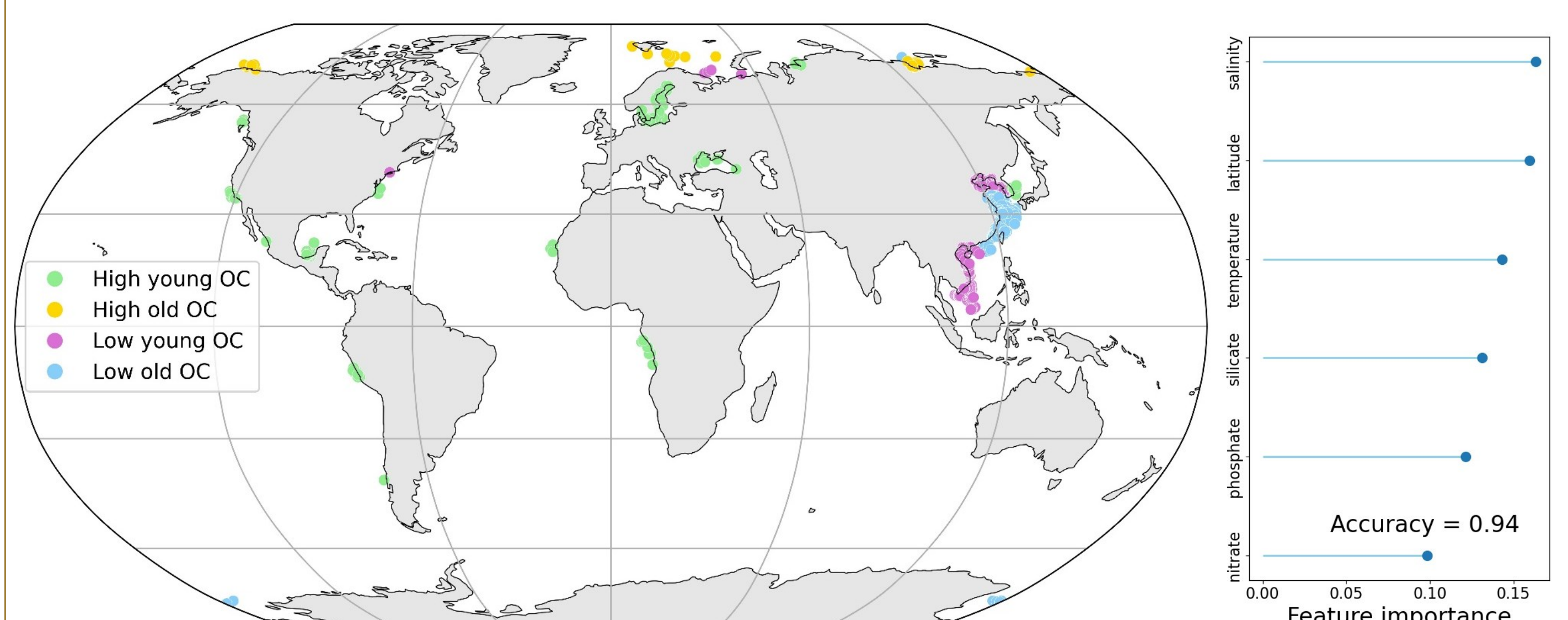

Fig. 4. Spatial distribution of OC and ^{14}C hotspots and coldspots, and the most influential features.

5 Conclusion

Distribution of spatial high/low OC is driven by factors that promote its production (i.e. upwelling margins) and degradation (i.e. broad shelves with lateral transport).

Spatial variations of young/old OC is governed by factors that prevent/promote its degradation (i.e. narrow margins and low oxygen, or broad shelves), or the release of aged OC (i.e. permafrost thawing).

References

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