

Supporting information for “Multi-colony tracking of two pelagic seabirds with contrasting flight capability illustrates how windscapes shape migratory movements at an ocean-basin scale”

Supplementary Table S1: Number of tracks per colony and per species. One track corresponds to the length of a year, from one breeding season to the next. (-) species absent or no data collected.

| Colony | Country | Longitude | Latitude | Black-legged kittiwake | Atlantic Puffin |
|-------------------------|----------------|-----------|----------|------------------------|-----------------|
| Alkefjellet | Norway | 18.459 | 79.585 | 88 | - |
| Anda | Norway | 15.17 | 69.065 | 146 | 48 |
| Bjørnøya | Norway | 18.956 | 74.503 | 111 | - |
| Cape Krutik | Russia | 35.948 | 69.151 | 128 | - |
| Faroe Islands | Faroe Islands | -6.798 | 61.95 | 145 | 49 |
| Franz Josef Land | Russia | 51.468 | 80.144 | 110 | - |
| Grimsey | Iceland | -17.992 | 66.529 | - | 55 |
| Hjelmsøya | Norway | 24.732 | 71.113 | - | 54 |
| Hornøya | Norway | 31.15 | 70.383 | 107 | 125 |
| Isfjorden | Norway | 15.508 | 78.253 | 134 | - |
| Isle of May | United Kingdom | -2.558 | 56.186 | 125 | 109 |
| Kara Gate | Russia | 55.021 | 70.593 | 41 | - |
| Kongsfjorden | Norway | 12.217 | 78.9 | 124 | - |
| Langanes and Skjalfandi | Iceland | -15.985 | 66.18 | 80 | - |
| Papey | Iceland | -14.172 | 64.588 | - | 74 |
| Runde and Ålesund | Norway | 5.874 | 62.436 | 103 | 64 |
| Røst | Norway | 11.91 | 67.447 | 156 | 168 |
| Sklinna | Norway | 10.995 | 65.202 | 136 | 39 |
| Total | | | | 1734 | 785 |

Supplementary Table S2: Number of deployments per species and per logger type.

| Species | Migrate Technology | | | | BAS/Biotrack/Lotek | | | Total |
|------------------------|--------------------|-----------|------|-----|--------------------|--------|--------|-------|
| | c65 | c65_super | f100 | w65 | mk18 | mk4083 | mk4093 | |
| Atlantic puffin | 301 | 28 | 167 | 34 | 0 | 76 | 59 | 665 |
| Black-legged kittiwake | 8 | 0 | 62 | 0 | 4 | 1402 | 39 | 1515 |

Supplementary table S3: Sampling frequency and recording intervals of light and saltwater immersion data specified for each logger model. For light, the maximum value sampled within a recording interval will be stored and used in subsequent analyses. For the saltwater immersion data, samples are binary (0 = no contact with saltwater; 1 = contact with saltwater) and the recorded value used in subsequent analyses is the accumulated value of samples made within the recording interval.

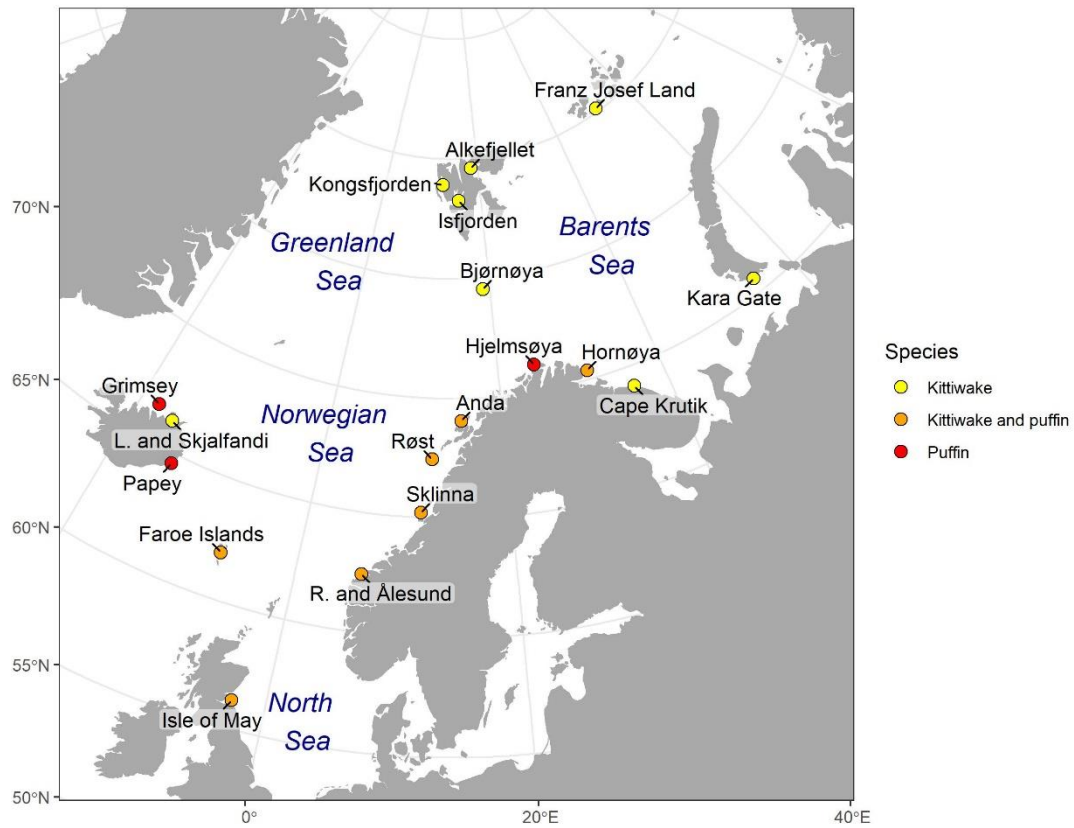
| model | light | | saltwater immersion | |
|-----------|----------|-----------|---------------------|-----------|
| | sampling | recording | sampling | recording |
| mk18 | 1 min | 5 min | 3 sec | 10 min |
| mk4083 | 1 min | 5 min | 3 sec | 10 min |
| mk4093 | 1 min | 5 min | 3 sec | 10 min |
| f100 | 1 min | 5 min | 30 sec | 10 min |
| c65_super | 1 min | 5 min | 30 sec | 10 min |
| c65 | 1 min | 5 min | 30 sec | 10 min |
| w65 | 1 min | 5 min | 30 sec | 10 min |

Supplementary Table S4: Number of individuals per species and number of years tracked.

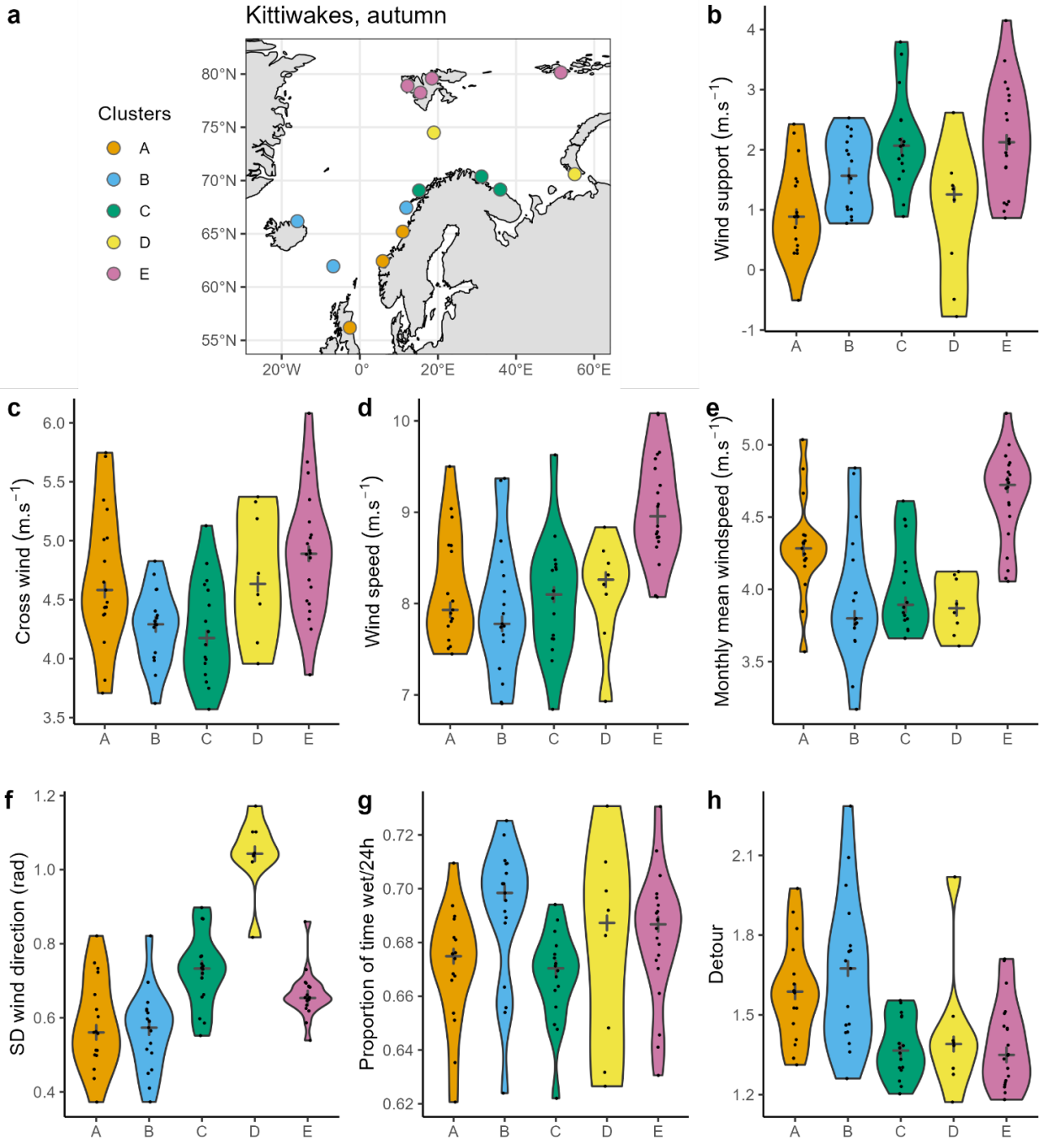
| Number of years tracked | Atlantic puffin | Black-legged kittiwake |
|-------------------------|-----------------|------------------------|
| 1 | 214 | 345 |
| 2 | 105 | 187 |
| 3 | 74 | 121 |
| 4 | 23 | 78 |
| 5 | 7 | 36 |
| 6 | 2 | 27 |

Supplementary table S5: Definition of the variables used for the cluster analysis. Each variable was obtained at each location (except detour with one value per migratory segment). Variables were aggregated, by calculating, for each season and species, the median value per migratory segment (except for detour), track, year and colony.

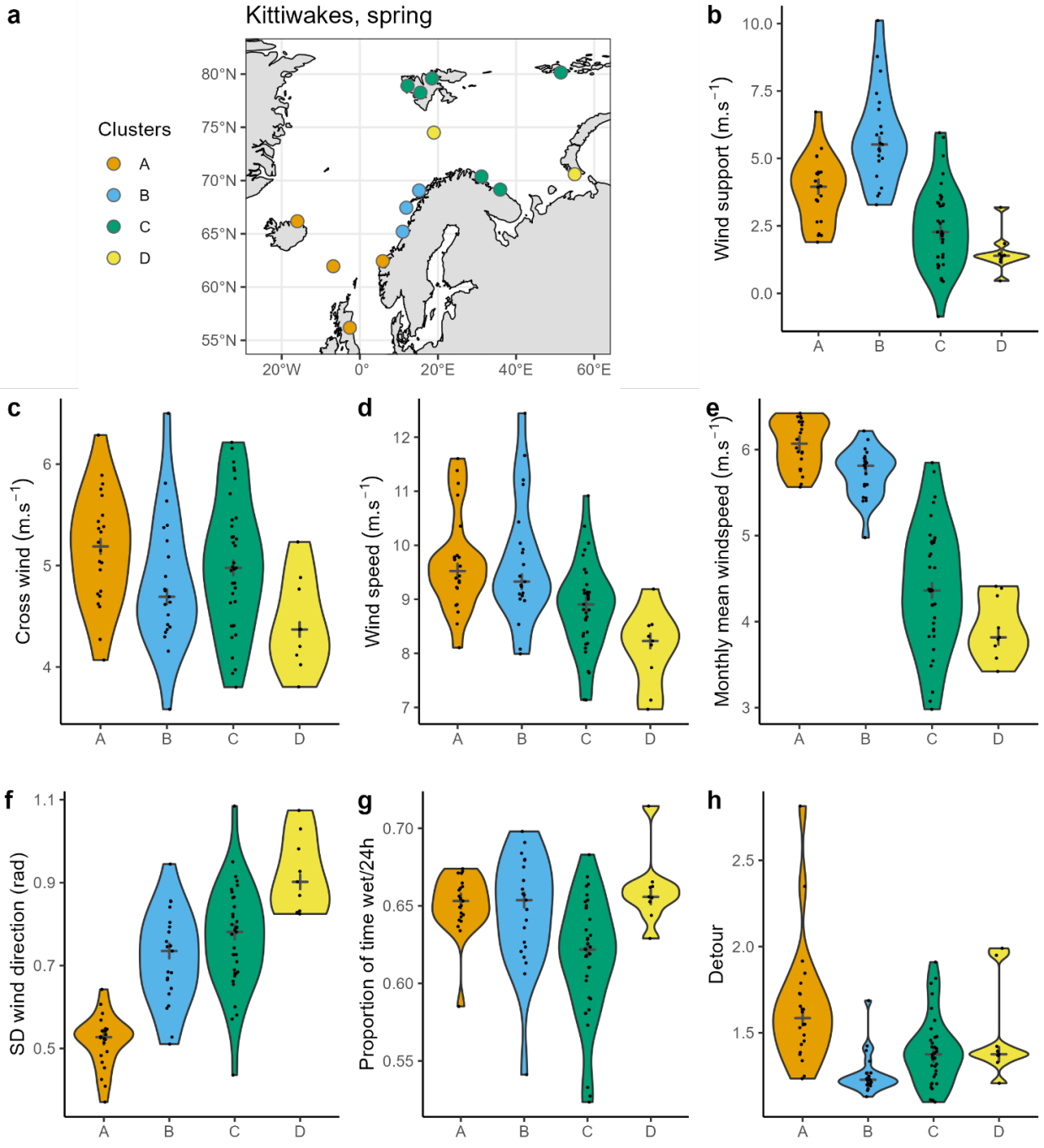
| Category | Variable | Definition |
|--------------------------|-----------------------------------|--|
| Daily wind conditions | Wind support | Wind component that is parallel to the bird ground speed. The wind support is positive with tailwinds and negative with headwinds. |
| | Cross wind | Wind component that is perpendicular to the birds' ground speed. The absolute value was used |
| | Wind speed | Norm of the wind vector |
| Expected wind conditions | Mean wind speed | Average wind speed per month over the study period (2014-2020) |
| | Variability of the wind direction | Standard deviation of the wind direction, per month over the study period (2014-2020) |
| Bird behaviour | Proportion wet per 24h | Proportion of time spent wet per 24h, proxy of time spent not flying |
| | Detour | Distance of the migratory segment divided by the distance of the shortest path |



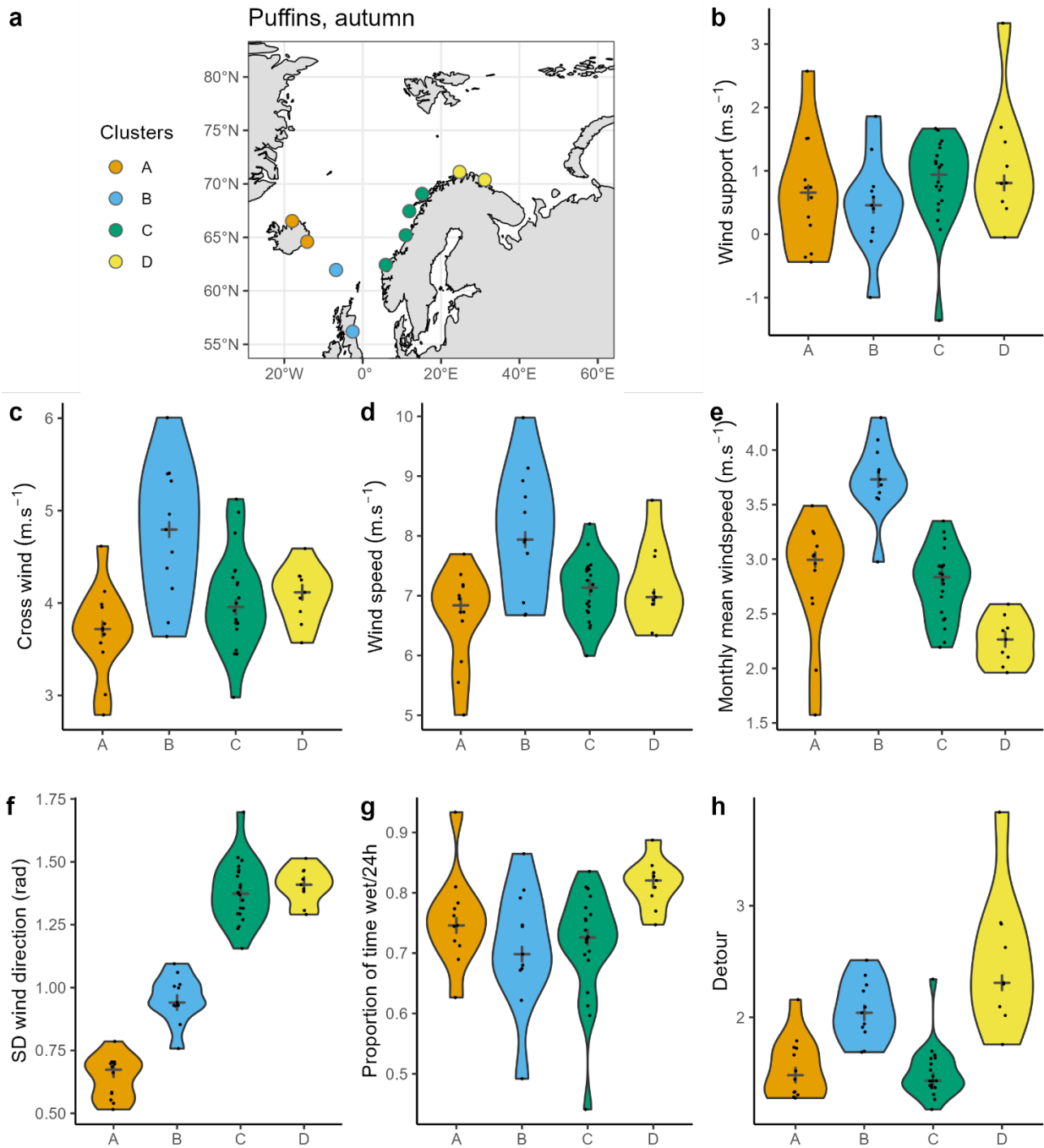
Supplementary figure 1: Location of the colonies where geolocator deployments took place. “R. and Ålesund” represents Runde and Ålesund, with kittiwakes breeding in Ålesund and puffins in Runde. “L. and Skjalfandi” represents Langes and Skjalfandi. Azimuthal equidistant projection centered on the median longitude and latitude of our dataset (Lon: -13.10°E, Lat: 64.27°N).



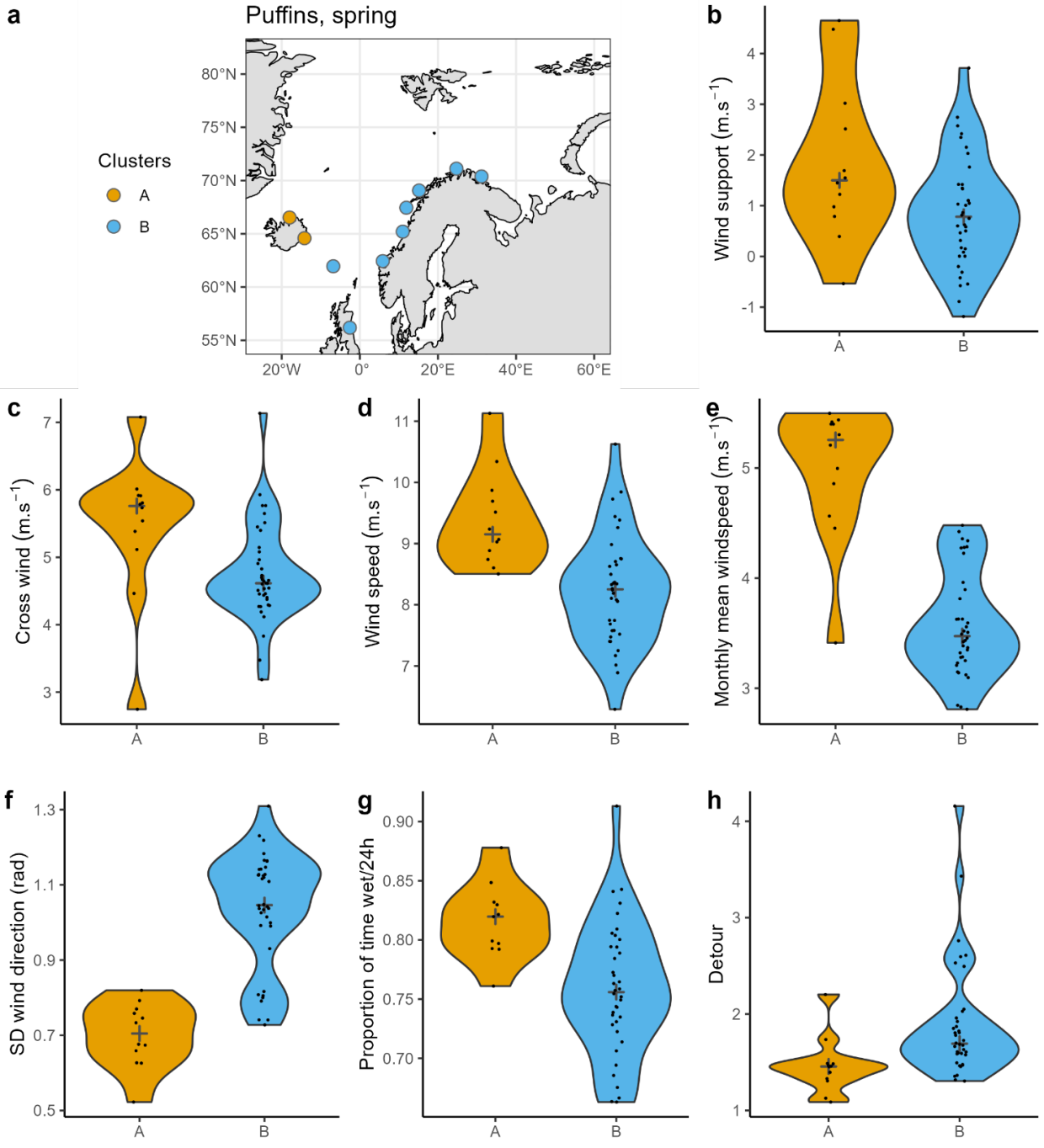
Supplementary figure 2: Result of cluster analysis to investigate similarities in windscaapes encountered by kittiwakes from different colonies during autumn migration. Cluster analysis was made with a median value per colony of wind support, cross wind and wind speed (representing encountered wind conditions), mean proportion wet and detour (representing bird behaviour), and standard deviation of wind direction and scalar average wind speed (representing average wind conditions). a) location of the colonies and associated clusters. Violin plots show for each cluster the distribution of the annual median per year and colony of b) wind support (m.s^{-1}), c) cross wind (m.s^{-1}), d) wind speed (m.s^{-1}), e) monthly mean wind speed (m.s^{-1}), f) standard deviation of the wind direction (rad), g) proportion of time wet per 24h, h) detour (migratory segment length divided by the beeline length). Grey crosses represent median for each cluster. Black dots represent median values per colony and per year. Detour is calculated as the ratio of the realised route distance divided the shortest route distance.



Supplementary figure 3: Result of cluster analysis to investigate similarities in windscaapes encountered by kittiwakes from different colonies during spring migration. Cluster analysis was made with a median value per colony of wind support, cross wind and wind speed (representing encountered wind conditions), mean proportion wet and detour (representing bird behaviour), and standard deviation of wind direction and scalar average wind speed (representing average wind conditions). a) location of the colonies and associated clusters. Violin plots show for each cluster the distribution of the annual median per year and colony of b) wind support ($m.s^{-1}$), c) cross wind ($m.s^{-1}$), d) wind speed ($m.s^{-1}$), e) monthly mean wind speed ($m.s^{-1}$), f) standard deviation of the wind direction (rad), g) proportion of time wet per 24h, h) detour (migratory segment length divided by the beeline length). Grey crosses represent median for each cluster. Black dots represent median values per colony and per year. Detour is calculated as the ratio of the realised route distance divided the shortest route distance.



Supplementary figure 4: Result of cluster analysis to investigate similarities in windscares encountered by puffins from different colonies during autumn migration. Cluster analysis was made with a median value per colony of wind support, cross wind and wind speed (representing encountered wind conditions), mean proportion wet and detour (representing bird behaviour), and standard deviation of wind direction and scalar average wind speed (representing average wind conditions). a) location of the colonies and associated clusters. Violin plots show for each cluster the distribution of the annual median per year and colony of b) wind support ($m.s^{-1}$), c) cross wind ($m.s^{-1}$), d) wind speed ($m.s^{-1}$), e) monthly mean wind speed ($m.s^{-1}$), f) standard deviation of the wind direction (rad), g) proportion of time wet per 24h, h) detour (migratory segment length divided by the beeline length). Grey crosses represent median for each cluster. Black dots represent median values per colony and per year. Detour is calculated as the ratio of the realised route distance divided the shortest route distance.



Supplementary figure S5: Result of cluster analysis to investigate similarities in windscape encountered by puffins from different colonies during spring migration. Cluster analysis was made with a median value per colony of wind support, cross wind and wind speed (representing encountered wind conditions), mean proportion wet and detour (representing bird behaviour), and standard deviation of wind direction and scalar average wind speed (representing average wind conditions). a) location of the colonies and associated clusters. Violin plots show for each cluster the distribution of the annual median per year and colony of b) wind support (m.s^{-1}), c) cross wind (m.s^{-1}), d) wind speed (m.s^{-1}), e) monthly mean wind speed (m.s^{-1}), f) standard deviation of the wind direction (rad), g) proportion of time wet per 24h, h) detour (migratory segment length divided by the beeline length). Grey crosses represent median for each cluster. Black dots represent median values per colony and per year. Detour is calculated as the ratio of the realised route distance divided the shortest route distance.