



# Supplement of

# Reanalysis representation of low-level winds in the Antarctic near-coastal region

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## 1 Detailed SOM conditions

### Table S1. Description of meteorological conditions associated with each SOM node.

#### Casey

| (0, 0)   | (0, 1)   | (0, 2)   |
|--|--|--|
| Weak pressure gradient.<br>Moderate southeasterlies onshore and<br>moderate easterlies offshore. | High pressure, reduced cloud fractions, strongly favourable for katabatic forcing. | Moderate pressure gradient,<br>moderately favourable for katabatic     |
|  | Strong southerlies onshore with weak easterlies offshore.                          | forcing. Strong southeasterlies onshore with weak easterlies offshore. |
| (1, 0)   | (1, 1)   | (1, 2)   |
|  |  | Strong pressure gradient directing                                     |
| Weak pressure gradient. Unfavourable   | Strong pressure gradient directing flow  | flow partially around the Law Dome.                                    |
| for katabatic forcing. Moderate southeasterlies  | into the Law Dome. Strong winds onshore  | Tip jet formation and favourable                                       |
| onshore and near-zero easterlies offshore.   | and moderate winds offshore.   | conditions for katabatic forcing. Strongest                            |
|  |  | winds onshore and offshore.  |

#### Dumont D'Urville

| (0, 0)   | (0, 1)  | (0, 2)   |
|--|---|--|
| Moderate pressure gradient.  | High pressure, reduced cloud fractions,   | Weak pressure gradient, reduced cloud,   |
| Moderate southeasterlies onshore and   | strongly favourable for katabatic forcing.  | favourable for katabatic   |
| strong easterlies offshore. Favourable katabatic   | Strong southerlies onshore with weak easterlies   | forcing. Strong southerlies onshore  |
| conditions.  | offshore.   | with near-zero easterlies offshore.  |
| (1, 0)   | (1, 1)  | (1, 2)   |
| Weak pressure gradient.<br>Moderate southeasterlies onshore and<br>strong easterlies offshore. Favourable katabatic<br>conditions. | Strong pressure gradient directing flow<br>along the coast east of DDU. Strong winds onshore<br>and offshore. | Strong pressure gradient directing flow<br>into the coast. Strong winds onshore<br>and offshore. |

#### Mawson

| (0, 0)                                      | (0, 1)   | (0, 2)                                   |
|---|--|--|
| Moderate pressure gradient.                 | High pressure, strongly favourable for         | Strong pressure gradient directing flow  |
| Moderate southeasterlies onshore and        | katabatic forcing. Strong southerlies onshore  | into the coast. Strong winds onshore     |
| moderate easterlies offshore.               | with weak easterlies offshore.                 | and offshore.                            |
| (1, 0)                                      | (1, 1)   | (1, 2)                                   |
| Weak pressure gradient. Favourable for      | Strong pressure gradient directing flow along  | Strong pressure gradient directing flow  |
| katabatic forcing. Moderate southeasterlies | the coast east of Mawson. Strong winds onshore | from the southeast. Strong winds onshore |
| onshore and near-zero easterlies offshore.  | and offshore.                                  | and moderate winds offshore.             |

#### Neumayer

| (0, 0)                                       | (0, 1)   | (0, 2)                                    |
|--|--|---|
| Weak prossure gradient directing flow from   | High process Weak winds anshare  | Moderate pressure gradient directing flow |
| the couth Week winds on shore and offshore   | and near-zero winds offshore.  | along the coast east of Neumayer.         |
| the south. weak winds offshore and offshore. |  | Moderate winds onshore and offshore.      |
| (1, 0)                                       | (1, 1)   | (1, 2)                                    |
| Strong pressure gradient directing flow from | Strong pressure gradient directing flow from the northeast. Strong winds onshore and offshore. | Strong pressure gradient directing flow   |
| the south. Moderate winds onshore and        |  | along the coast east of Neumayer.         |
| offshore.                                    |  | Moderate winds onshore and offshore.      |

#### 2 Seasonal breakdown of ASCAT results



**Figure S1.** Mean ERA5-collocated ASCAT 10 m wind speed (shaded) and wind field (wind vectors) for the period 2010-2017 for individual calendar months from (a) January to (l) December. The same hatching of missing data, orography contours and demarcation of the coastal easterly zone is used as in Figure 4.



**Figure S2.** Mean ERA5 minus ASCAT 10 m wind speed for the period 2010-2017 for individual calendar months from (a) January to (l) December. The same hatching of missing data, orography contours and demarcation of the coastal easterly zone is used as in Figure 4.



Figure S3. As in Figure S2 but for MERRA-2.



Figure S4. As in Figure S2 but for JRA-55.



**Figure S5.** Mean reanalysis minus ASCAT 10 m zonal wind (left column) and meridional wind (right column) for the period 2010-2017 for (a-b) ERA5, (c-d) MERRA-2 and (e-f) JRA-55. Hourly data are used for ERA5 and MERRA-2 with six-hourly from JRA-55. Data points which are rain flagged or have a GMF-matchup flag value over 2 are not included and pixels with fewer than 50 ASCAT-reanalysis collocations are masked. Orography at 300 m intervals (from the ERA5 invariant fields) is marked with grey contours. The region within the red contour is the coastal easterlies domain, identified where either the ERA5 2010-2017 mean zonal wind is less than zero or the location is within a 12-gridbox buffer drawn from the coast.

#### 4 Full SOM scatterplots and profiles



**Figure S6.** Reanalysis-observation wind intercomparison by SOM node at Casey for (a-f) ERA5, (g-l) MERRA-2 and (m-r) JRA-55 for the period 2010-2017. For each node is plotted: (left) scatterplots of observed vs reanalysis 10 m wind speeds and (right) vertical profiles of mean wind speed (black), u wind (blue), v wind (green) and temperature (red) from observations (solid) and reanalysis (dashed). Shading in the background of each profile indicates the correlation coefficient between observed and reanalysis wind speed at that level. Nodes with limited synoptic forcing but favourable conditions for katabatic forcing are labeled with a [Kat].



Figure S7. As in Figure S6 but for DDU.



Figure S8. As in Figure S6 but for Mawson.



Figure S9. As in Figure S6 but for Neumayer.



**Figure S10.** (a) Frequency of temperature inversions with height at Casey (green), DDU (red), Mawson (blue) and Neumayer (orange), with temperature inversions defined as occurring where temperature increases with height for a given 10 m level in the sonde observations for the period 2010-2017. (b) Mean correlation coefficient between observed and reanalysis wind speeds with height for the period 2010-2017, using the same colour scheme for ERA5 (dashed), MERRA-2 (dotted) and JRA-55 (dash-dotted).