# Ajuste numérico do campo do vento de superfície na CLP da região da Estação Antártica Brasileira Comandante Ferraz (EACF)

## Topographic numerical adjustment of the surface wind field in the PBL on the region of the Brazilian Antarctic Station Comandante Ferraz (EAFC)

Mariana Fadigatti Picolo[1], Jacyra Soares[2]

[1]Master's Student, Group of Micrometeorology, Department of Atmospheric Science, University of São Paulo, São Paulo, Brazil

[2]PhD, Group of Micrometeorology, Department of Atmospheric Science, University of São Paulo, São Paulo, Brazil

### Resumo

*O campo de vento é importante para estudos de interação da superfície com a atmosfera. Na região Antártica a topografia exerce grande influência no campo de vento, sendo que medidas observacionais podem não representar o campo de vento adequadamente. Ao redor da estação antártica brasileira Comandante Ferraz (EACF), localizada na Ilha do Rei George, geleiras chegam até 700 m. O objetivo deste trabalho é gerar o campo de vento em torno da EACF. Primeiramente, a rotina foi inicializada utilizando ventos de norte, sul, leste e oeste para verificar o efeito da topografia em ventos com diferentes direções. Após, a rotina foi inicializada com valores de intensidade e direção médios para verão e inverno. A velocidade do vento é maior em maiores altitudes e menor em altitudes mais baixas, devido à conservação de massa. A topografia acelera o fluxo e modifica sua direção inicial, com exceção da região da geleira Arctowski, a norte da estação. É possível observar o fluxo ir para áreas mais baixas, em algumas regiões, como ao redor da estação, com velocidades maiores que o vento inicial. Não é possível caracterizar os efeitos térmicos no vento, no entanto pode ser visto o efeito topográfico no campo de vento.*

***Palavras-chave****: Antártica, Ilha do Rei George, topografia,vento , EACF.*

### Abstract

*The wind field is important to atmosphere surface interactions. In the Antarctic region, the topography has a big influence on the wind field, and observational measures may not represent the wind field adequately. Around the Brazilian Antarctic station Comandante Ferraz (EACF), located at the King George Island, icefields reach up to 700 m. The objective in this work is generating wind field around EACF. At first, the routine was initialized using winds from North, South, East and West to verify the topographic effect on winds with different direction. Later, the routine was initialized using average wind speed and direction for summer and winter. The wind speed is higher on the higher terrains and lower on lower areas, because of mass conservation. The topography accelerates the flow and changes its original direction, except on the region of the Arctowski Icefild, North of the station. It is possible to observe wind flowing to lower areas, in some regions, as seen around the station, with speed higher than the initial wind. It is not possible to categorize the thermal effects on the wind, but it can be seen the topographic effect on the wind field.*

***Keywords****: Antarctica, King George Island, topography, wind, EACF.*

## 1 Introduction

In the Antarctic region, winds are strongly influenced by the local topography and winds at one station may not give a good image of the surface wind field (King and Turner 1997).

The Brazilian station Comandante Ferraz, EACF, on Antarctica (62°05S', 58°23'W), is located at King George Island, 20 m above sea level.

Wind fields are important to a number of studies of atmosphere, surface interaction and environmental impacts. According to Ratto et al (1994) correctly 3-D wind fields could be useful for formulating initial and boundary conditions required by mesoscale dynamical models. The wind field obtainment is limited, according to Veleda (2001), because of spatially scattered measures, particularly in regions with complex terrain.

A simple way of reproducing mesoscale fields in complex terrain would be the development of diagnostic models, capable of reproducing mesoscale meteorological fields with great resolution and details (Mass and Dempsey, 1985). The relative simplicity of diagnostic models makes them attractive for many practical purposes, because they do not require much input data and are easy and economical to operate (Ratto et al., 2004).

In this work, it will be used a diagnostic model proposed by Anderson (1971) which assume physical restrictions such as mass conservation and incompressible atmosphere. The routine described by Anderson (1997), assumes vertical motion limited superiorly by the top of the planetary boundary layer (PBL) height and inferiorly by the topography. In this routine, the PBL height is summed with the topography height.

## 2 Methodology

To run the routines it is necessary wind data, topography data and PBL height of the region.

The wind data used was obtained on EACF by the project ETA ("Estudo da Turbulência na Antártica") and was measured at 10.1 m of height. The data was sampling with frequency of 10 s and was storaged as 5-minute average. The description of the sensor utilized to measure the investigated variable is shown in Table 2.

Table 2- Description of the sensor installed at the Comandante Ferraz station.

| | Sensor | | Range | Acuracy |
|---|---|---|---|---|
| Wind | Anemômetro RM Young Model: 05103 | Speed | 0-100 $ms^{-1}$ | ± 0.3 $ms^{-1}$ |
| | | Direction | 0-360$^o$ | ± 3 $^o$ |

It was not found PBL height data for the region studied. King and Turner (1997) present data from the Halley station, which is a coastal station (75°35’S, 26°39’36’’E) with an elevation of about 30 m above sea level. Under near-neutral conditions, it was found a PBL height around 150 m. For this study, it was used 100 m, considering that the atmosphere is expected to be stable to neutral and considering the result found at Halley station.

To verify the topographic effect on the wind field from different wind directions, the routine was initialized using wind from North, South, East and West directions and intensity of 1 $ms^{-1}$.

After, the routine was initialized using average values of observed wind intensity and direction for summer and winter conditions. The average was obtained using observed 5-minute data of 2014.

## 3 Results and Discussions

The region studied has 32 x 32 km with constant spatial resolution of 50 m with 641 x 641 points (Fig. 1).

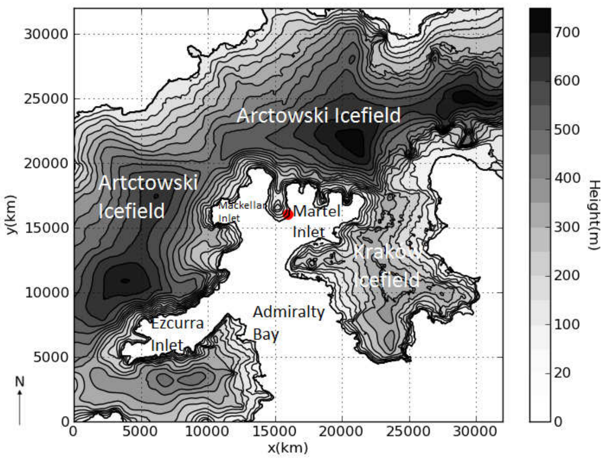


Figure 1- Topography around the station Comandante Ferraz (red dot). Map adapted from the digital terrain model of Braun et al. (2011).

Topographic elevations present values as high as 700 m.

For winter condition, was used a wind speed of 6.9 $ms^{-1}$ with direction of 349° and for summer, a wind speed of 5.9 $ms^{-1}$ with a direction of 56°.

The results are displayed in Figs 2, 3 and 4 with, respectively, 1000 m and 200 m contour intervals for better visualization. The initial wind is shown, with scale, for each case.

The wind speeds is higher on the higher terrains and lower on lower areas, due to mass conservation (Fig 2, 3 and 4).

The topography accelerates the wind and changes its original direction, except on Arctowski Icefield on the north sector of the station. In that region, the flow maintains the original direction of the wind for the four cases studied (Fig 2 and 3).

In some areas, it is also possible to see the wind flow to lower areas with speed higher than the initial, for example on Mackellar Inlet (West of the station, Fig 1) (Fig 2c and Fig 3a), on the South sector of the Kraków icefield (Southeast of the station, Fig 1) (Fig 2a) and on the Southeast sector of the Kraków icefield (Fig 3c).

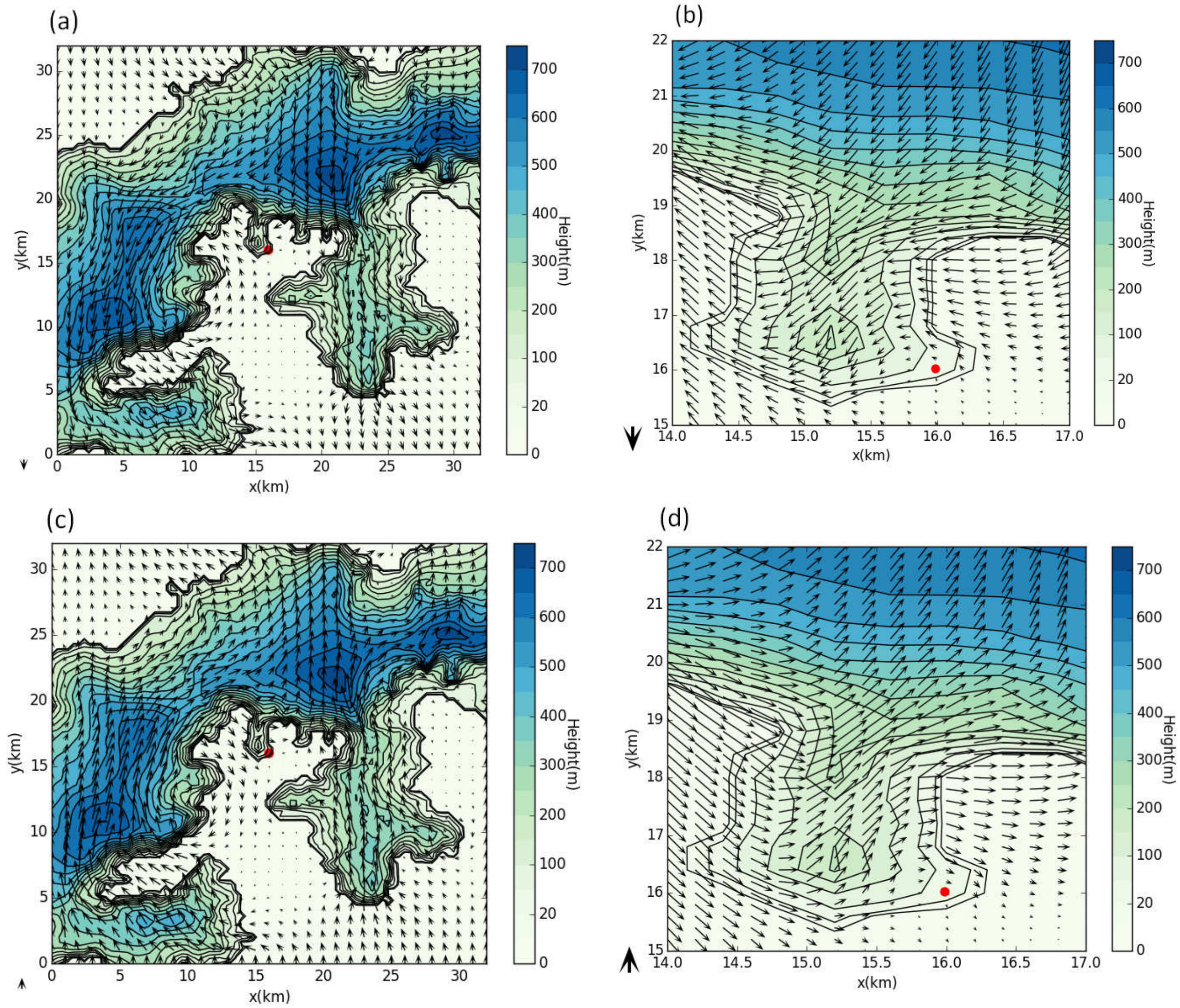


Figure 2- Wind field for (a) and (b) North, (c) and (d) South initial wind.

On the Keller Peninsula, where the station is located (red dot in Fig. 1), flow to lower areas is also seen for the North and East initial winds (Fig 2b and Fig 3b), with speed higher than the initial wind. Around the EACF, for those cases (North and East initial field), wind is flowing from the continent to the peninsula and to the ocean (Fig 2b and Fig 3b).

For the South and West initial winds, flow is from the ocean to the continent, around the station (Fig 2d and Fig 3d).

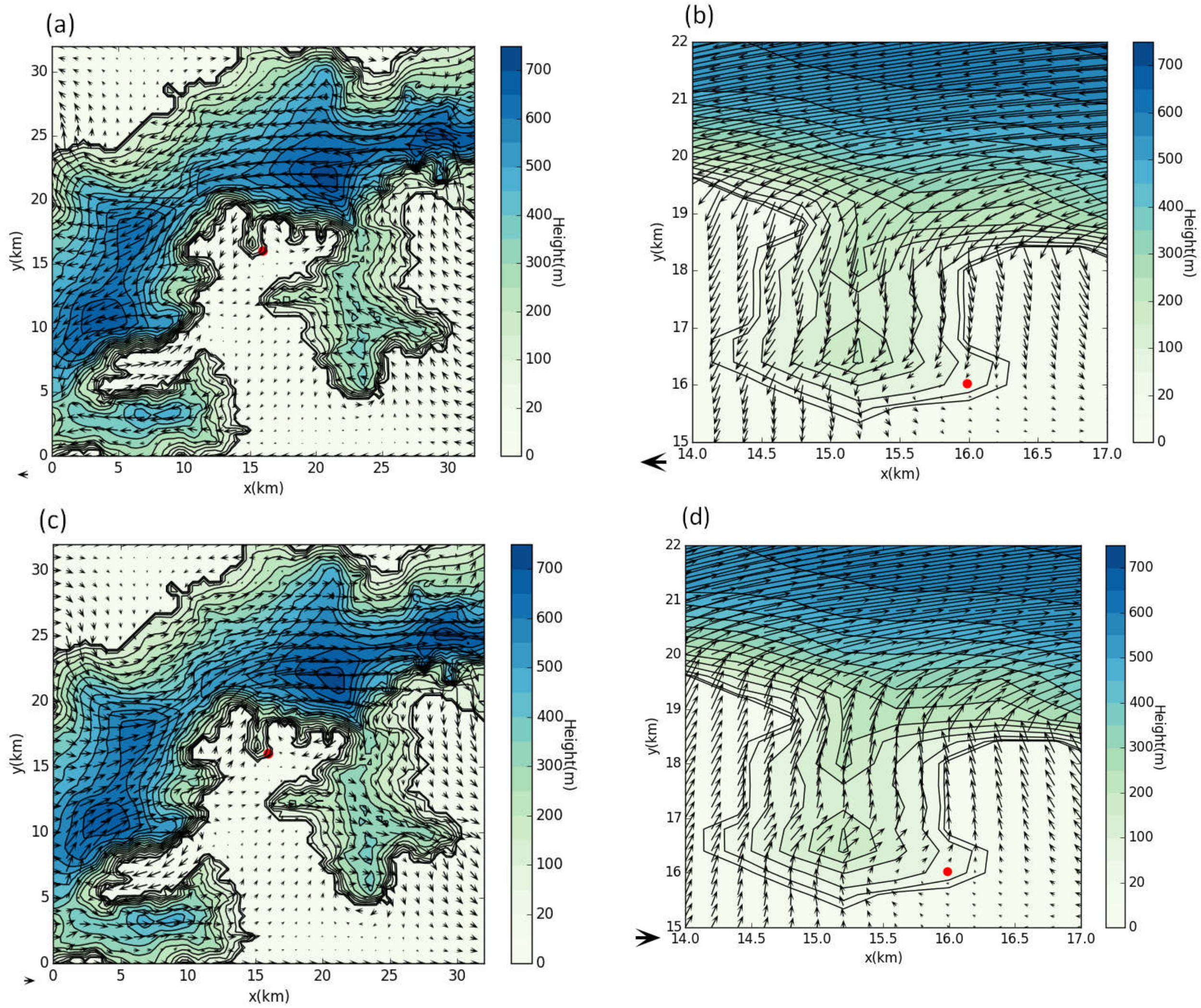


Figure 3- Wind field for (a) and (b) East, (c) and (d) West initial wind.

In all cases, a channeling effect on Ezcurra Inlet (Southwest of the station, Fig 1) is seen.

The wind field obtained using the summer average value as an initial condition is similar to the one for the East initial field, because the summer average direction has an east component (Fig 4a).

For the winter initial wind, the adjusted wind field is similar to the one using a North initial wind, because the average winter direction is North (Fig 4c).

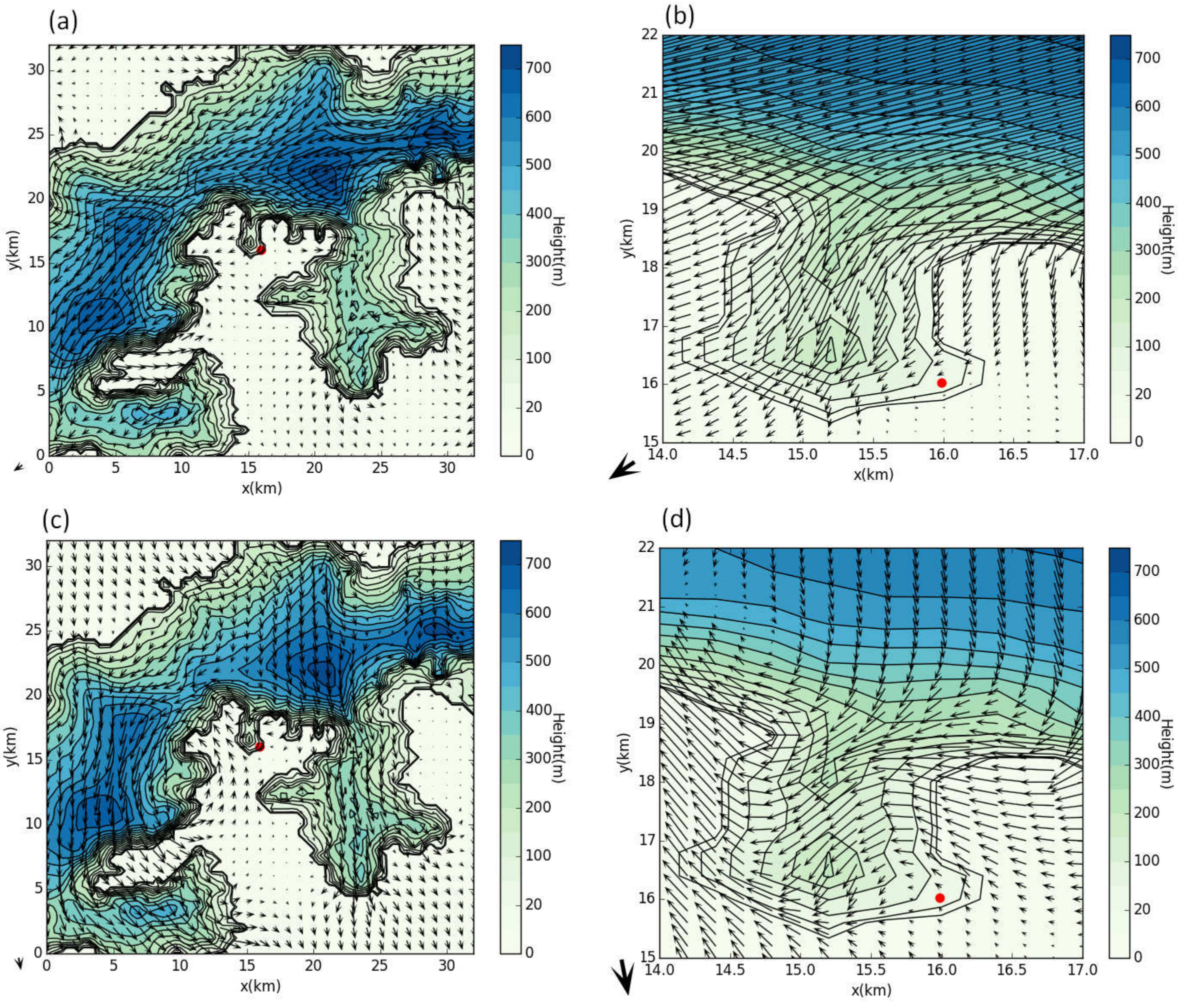


Figure 4- Wind field for (a) and (b) summer, (c) and (d) winter initial wind.

Again, flow to lower areas is seen on some regions, as around the station (Fig 4b and d), with wind speed higher than the initial.

Wind is flowing from the continent to the Keller Peninsula and to the ocean for summer and winter initial field, around the EACF (Fig 4b and d).

## 5 Conclusions

This work analyzed topographic wind field adjustments on the region of the Antarctic Brazilian Station (EACF).

For all cases, the wind speed is higher on higher topographic areas and lower on lower topography and flat regions, due to the mass conservation.

It was observed winds flowing to lower regions on all shown cases, it is possible to see it around the Keller Peninsula for the North and East initial field (Fig 2b and Fig 3b) and for the summer and winter initial condition (Fig 4b and b) and. In those four cases, the wind is coming from the continent to the ocean, around the EACF. The winds flow from the water of Mackellar Inlet and Admiralty Bay to the continent (Fig 2d and Fig 3d), for the South and West initial wind. A channeling effect is observed on Ezcurra Inlet, again, for all the cases studied.

One disadvantage of this diagnostic routine is that is not possible to identify the thermal effects on the wind. Nonetheless, it is possible to see the topographic effect on the wind.

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