

The manuscript entitled "*Application of Chemistry-climate model SOCOL-AERv2-BEv1 to cosmogenic beryllium isotopes: Description and validation for polar regions*"

is generally well written and deals with an interesting topic, since it comes to fill a lack of knowledge regarding the behavior of  $7\text{Be}$  and  $10\text{Be}$  in polar regions.

There is a detailed and comprehensive analysis of data with figures and Tables to add to this complete analysis.

It is valuable for the scientific community and can be published in *Geoscience\_Model\_Development* after some minor revisions

Before my comments for some minor revisions, I'd like to make some general comments reading the revised manuscript.

I agree with the authors that "...the two beryllium isotopes are believed to have similar transport/deposition properties being different only in the production and the lifetime, thus the results of  $7\text{Be}$  transport can be generally applied to  $10\text{Be}$ ." (lines 10-12, and 56-58 of the revised manuscript).

No further discussion is needed, no doubts, and not any further clarifications.

For sure the reviewers' comments and queries helped the authors to clarify any ambiguity.

The authors reply in details to reviewers' comments and the text is clear.

Regarding the weekly data that the authors use in their analysis, I find it absolutely scientifically correct, since daily data and discrepancies due to various reasons do not allow the scientists (the authors in our case) to proceed with reliable conclusions. It is great advantage that Finland has so many stations with so long recorded weekly data. It is almost impossible to find something similar anywhere in the world. Furthermore in lines 130-136, the authors explain more than satisfactory the reasons for using the weekly data in their analysis.

I find extremely interesting and valuable a model like the proposed one in this manuscript: "*The new model version SOCOL-AERv2-BEv1 that has been developed here for systematic modelling of  $7\text{Be}$  and  $10\text{Be}$  production, transport and deposition in the atmosphere and the main purpose of this work is to present a new combined model of beryllium production and transport and to confront its results with high-resolution (weekly) measurements of  $7\text{Be}$  in near-ground air and precipitating water in polar regions has been successfully achieved.*"

It is a knowledge that was missing and this work is valuable from the scientific community.

And yes, there are many papers regarding the  $7\text{Be}$  in mid latitudes, but these data cannot be used and/or applied to  $7\text{Be}$  at high latitudes and its behavior (similarly  $10\text{Be}$ ). And only in Polar Regions can be studied the solar energetic-particle event (SPE) and their influence in  $7\text{Be}$  concentrations.

## Proposed revisions:

-1-

In my opinion, there is a confusion with the names-abbreviations of the models that are mentioned in this work (***SOCOL-AERv2-BEv1***, ***SOCOL***, ***CCM SOCOL***, ***SOCOL v3.0***, ***SOCOL-AERv2***, ***CCM SOCOL-AERv2***, ***SOCOLv3.0:Be***, ***SOCOLv3.0***). See abbreviations in text at section -4- bellow.

My suggestion to the authors is to try to “keep a unique form” as much as possible with the model abbreviations, e.g. I do not understand if there is any difference between the CCM SOCOL and SOCOL. For sure if there is a difference they authors should keep the different abbreviations, but if not please keep just one.

-2-

The name of the model that is developed here ***SOCOL-AERv2-BEv1***, is mentioned only once in the title and once at the line 123 of the manuscript.

**In my opinion, the name of the model must be added in the Abstract and in the Conclusions.**

-3-

Furthermore, since it is “*a new developed model*” it could be mentioned somehow in the title. But this is not mandatory and the authors will decide for the title of the final paper. It’s just a proposal.

-4-

Below I mention some parts of the text with the abbreviations of the model that at least in my case produced a slight confusion.

*Title: “.....SOCOL-AERv2-BEv1....”*

### *Abstract*

Lines 12-13: “*based on the chemistry-climate model SOCOL (Solar Climate Ozone Links) v3,...*”

lines 25-26: “*Thus, a new full 3D time-dependent model, based on the SOCOL v3.0, of <sup>7</sup>Be and <sup>10</sup>Be atmospheric production, transport and deposition have been developed.*”

**In my opinion, the development of the new model must be mentioned in title.**

### *1 Introduction*

Lines 58-60: “*Here we develop such a model to trace isotopes of <sup>7</sup>Be and <sup>10</sup>Be in the atmosphere based on the chemistry-climate model SOCOL (Solar Climate Ozone Links) v3, which has been specifically modified by including modules for the production, deposition, and transport of <sup>7</sup>Be and <sup>10</sup>Be.*”

### *2 Summary previous and existing models*

Lines 108-110: “*Here we present a new development of the full chemistry-climate model (CCM) Solar Climate Ozone Links (SOCOL) for modelling of production, transport, and deposition of the cosmogenic isotopes of beryllium as well as its validation with the available measurements of <sup>7</sup>Be at high-latitude locations. The CCM SOCOL is potentially capable of simulation*”

Lines 112-115: “*A recent model version SOCOL-AERv2, which simulates aerosols more realistically does not, however, include the treatment of all processes relevant to the beryllium life cycle and its applicability has not been evaluated. We have **further upgraded the CCM SOCOL-AERv2** (Feinberg et al., 2019) here, by adding the production, transport, and deposition of <sup>7</sup>Be and <sup>10</sup>Be isotopes from both GCR and SEPs.*”

Lines 123-124: *“The new model version **SOCOL-AERv2-BEv1** has been developed here for systematic modelling of 7Be and 10Be production, transport and deposition in the atmosphere.”*

**It is the first time that the authors mention the name of the model that has been developed and presented in this work.**

**In my opinion, the name of the model must be added in the Abstract and in the Conclusions.**

#### *4 Model description*

Lines 171-172: *“We used an extended version of the **CCM SOCOLv3** (Stenke et al., 2013) with the aerosol module - **SOCOL-AERv2** (Feinberg et al., 2019).”*

Lines 179: *“SOCOL uses the horizontal resolution T42, where....”*

Line 200: *“... used as an input for the **SOCOL** model,...”*

Line 258: *“...are realistically modelled by the **CCM SOCOL** (Feinberg et al., 2019)....”*

#### *6 Evaluation of the model by comparison with direct 7Be measurements*

Line 387: *“...deposition modelled by **SOCOL**...”*

#### *Conclusions*

Line 394: *“...The model named **as SOCOLv3.0:Be** is based on the chemistry-climate model **SOCOL**, specifically..”*

Line 411: *“Concluding, a new full 3D time-dependent model, based on **SOCOL-AERv2**, of 7Be and 10Be....”*