General Comments.

The paper certainly gives a long missed overview about CRAICC and from that reason the paper is highly welcomed. The authors certainly are capable of writing the paper and I certainly do support the publication.

The authors list carefully all the topics treated so far in CRAICC. They point also to missing observations. They put emphasis to overlooked facts, like Iceland being a strong desert particle source. In the last century, such a paper would have been written by one or two authors with proper credit to all contributors. Today, that paper (45 pages text) has been written by some 63 authors, meaning ¾ pages of text for each of them!

However, that paper is missing an ordering hand. The specific comments and technical corrections will show that. Among those many authors, it should have been possible devoting one looking for formal mistakes. This would ease the work of the reviewers.

Specific Comments.

Page 4, line 14 and many other places. Air pollutants: this is a valuing term. Scientific papers should be without valuing terms (impurities, and others), except it is clearly proven, like "anthropogenic pollution". Atmospheric trace gases are no impurities, they are minor constituents.

Page 5, line 10 and many other places. The emissions of sea spray aerosol. Sea water contains not only water-soluble salts, it also contains large amounts of insoluble biological material with the potential of turning into aerosol particles if injected into the atmosphere. This biological material (microbes for instance) is mentioned in this paper only for snow, page 7, line 12 and on page 6, line 30 as "sea salt and primary organic aerosols".

"*A microorganism, or microbe, is a microscopic organism, which may exist in its single-celled form or in a colony of cells (Wikipedia). In the open ocean, far from the influences of coastal human habitation, sea water still contains huge numbers of microbes. Coastal areas can contain even greater concentrations. Vast numbers of bacteria and plankton occur both at the surface and in deep ocean waters. Viruses are entities that require bacteria or other cells in order to make copies of their genetic material and to construct new casings that house the genetic material. Scientific studies have shown that 10 to 100 million viruses can be present in a teaspoonful of sea water (Wikipedia)*.

The concentration is about 5 10^9 microbes per liter or 5 10^6 cm^{-3} (F. Azam, T. Fenchel, J. G. Field, J. S. Gray, L. A. Meyer-Reil and F. Thingstad (1983): The Ecological Role of Water-Column Microbes in the Sea. Marine Ecology). Blanchard, D.C.L.D. Syzdek (1972, Concentration of Bacteria in Jet Drops from Bursting Bubbles. J. Geophys. Res. 77, 5087-5099) have shown that the concentration of bacteria in rising and bursting bubbles might increase by a factor of 1000. Not to mention the contribution of Leck and Bigg to "biological" aerosol from Artic leads; and Cindy Morris (and the papers, she is pointing) to Biological Ice Nuclei at all. If all those primary biological particles are of minor contribution to the Arctic aerosol, that should be stated in this paper. Alternatively, it also should be stated, why primary biological particles are not treated in CRAICC!

Snow in the Arctic (below 0°C) behaves like dust in a desert. Parts of it are reinjected into the atmosphere by turbulent winds. If snow contains microbes (page 7, line 12), they are reinjected and are becoming part of the Arctic aerosol.

BTW: Bare lands (Iceland) are behaving the same way.

You have capable biologists in your list of authors.

Page 18, line 5. This critical statement about the performance of satellites should include that only atmospheric tracers with a rather long residence time (~ one week) should be observed, because of the orbit parameters and the swath width. That means, a full global coverage is only available after one week. In Polar Regions that might be different (page 21, line 8?).

Page 27, line 10. Description of Iceland as a desert is a duplication. See my remarks about an ordering hand.

Page 37, line 1. It should be indicated, how many days it's raining. If the precipitation is occurring only at a few days, dry deposition is more effective.

Page 38, line 22. "Legacy of CRAICC" has the taste of self-praise (self-praise is no recommendation). This number 5 could most probable be removed.

Page 40, line 19. What are "ageing time scales"?

Page 46, line 32. “Climate models are mathematical representations of our understanding of the climate system”. I strongly disagree to that phrase. “Climate models are mathematical representations of our ability to model the climate system”.

Technical Corrections.

Page 4, line 34. CO_2.

Page 5, line 4. IPCC 2013 is not in the reference list.

Page 7, line 31. 10-5 thousand years BP could be misunderstood. Better would be “five to ten thousand years BP”.

Page 14, line 27. Instead of “formation” use better “production”.

Page 15, line 30. The term “below cloud scavenging” is much more common.

Page 15, line 21. “The dispersion model considers BC as an inert pollutant with a size distribution described by a single size bin ranging from 0.001 to 1 µm in dry particle diameter” – This is no size distribution.

Page 18, line 14. 7x7 km2 is misleading and 13x24 km2 as well. Are you meaning 7x7 km? A better term would be “$7 \cdot 7\ \mathrm{km}$”.

Page 18, line 18. A number of commas are missing.

Page 19, line 29. “system perturbation”. Better is “displacement”, perturbation could have a valuing meaning.

Page 20, line 27. “1,000 µg m [next line] ^{3} during 24-hour intervals”. The authors should look to a better handling of their word processors. This bad printing occurs, because the authors are not aware of the different hyphens. It should mean “1,000 µg m^{-3}”?

Page 23, line 7. Better “Secondary organic aerosol precursor sources”.

Page 26, line 8. “important source of absorption” – look for a better term.

Page 27, line 3. What are “wet wind conditions”?

Page 29, line 18, 19: Better than 9 ka, 5 ka might be 9000, 5000 years BP.

Page 30, line 12. The paper should include errors. 0.09 to 0.10 mm h^{-1} are very close together. That certainly is falling into the error bars.

Page 32, line 5. What is “organic sea spray”?

Page 35, line 30. A better term for “challenging” might be “questioning”.

Page 41, line 25. “65% of the territory” – what territory? That of Russia?

Page 43, line 11. What is “uncovering of Arctic waters”?

Page 45, line 2, and 3. Better use CO_2.

Page 45, line 14. 0°C.

Page 45, line 18. Better than “meteorological” is “environmental”. This page contains many judgmental terms.

Page 47, line 21. CO_2

The **5 References** should be kept uniform. Use something like EndNote.

Page 58, line 14. Omit line.

Page 63, line 11. Even if the journal recommends a citation, it should be kept in agreement with all the other references. On this page, many pages in the references are missing.

Page 65, line 26, Omit line break.

Page 66, line 34. Omit pp.

Page 67, line 13. Omit Vol.

Page 69, line 16. Pages of Atmos. Environ. are non-sense.

Page 69, line 24. Omit Vol., pp.

Page 71, line 34. Add authors.

Page 72, line 1. Left hand margin.

Page 75, Figure 4. The Figure should be blown up. The island Iceland would be sufficient. The units should be written as in the remainder of the paper.

Page 76, Figure 6. Much too small.

Page 77, Figure 7. Better than “cnts/L” might be “#/L”. Why are the x-axis’ equally spaced despite the fact, that the time steps are not.

Page 77, line 9. Give RH in %, $RH_w \geq 105\%$.

Page 78, Figure 9. Too small.
Page 79, Figure 10. Too small.
Page 80, Figure 12. Too small.
Page 80, Figure 13. Much too small