Comparing microphysical cloud properties from remote sensing with cloud parcel model results

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11th ISTP, Toulouse, France, 20th to 24th of May 2019
Motivation

\[ \text{Clouds} = \text{Particles} + H_2O \]
Motivation

Cloud: $\text{PMA} + \text{SMA} = \text{H}_2\text{O}$

References:
- Based on ground level in-situ measurements (Antarctic cruise)
- Fossum et al. (2018), doi:10.1038/s41598-018-32047-4
Motivation

\[ \text{PMA} + \text{SMA} = \text{H}_2\text{O} \]
Motivation

[Image of cloud and wave symbols, illustrating a chemical reaction:]

\[ \text{PMA} + \text{SMA} + \text{H}_2\text{O} \]

[Caption: based on ground level in-situ measurements (Antarctic cruise)]

- Fossun et al. (2018), doi:10.1038/s41598-018-32047-4
Motivation

$$\text{Motivation} = \text{PMA} + \text{SMA} + \text{H}_2\text{O}$$
Motivation

- based on ground level in-situ measurements (Antarctic cruise)
- Fossum et al. (2018), doi:10.1038/s41598-018-32047-4
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- in-situ aerosol measurements at ground level (model input)
- collocated profiling of microphysical cloud properties
- Model validation: Closure of parcel model and remote sensing?
SYRSOC – SYnergistic Remote Sensing Of Clouds

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- assumption: mono-modal cloud droplet size distribution
- single-layer purely liquid water clouds without precipitation
Pyrcel

- python-based adiabatic cloud parcel model
- [https://pyrcel.readthedocs.io/en/](https://pyrcel.readthedocs.io/en/)
- Rothenberg et al. (2016), doi:10.1175/JAS-D-15-0223.1
**Pyrcel**

- initial aerosol population of various species, modes
- derived from aerosol chemistry (AMS) and number size distribution (SMPS)
- input of meteorological conditions (T, RH, p, updraft)
- sensitivity study: sensitive to updraft, mode positioning, critical diameter
- constrain updraft from CCN supersaturation spectra
Cloud study on 14 and 15 August 2017
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- summer case, high fraction of marine organic aerosol
- accumulation mode concentration about 91 particles/cm³ (7% sea salt)
Cloud study on 19 February 2019

- winter case, with high sea salt concentration
- accumulation mode concentration about 230 particles/cm³ (71% sea salt)
Summary and future work

- comparing remote sensing cloud profiles with parcel model
- difficult to find cases due to limitations of SYRSOC and availability of instruments
- large variability in SYRSOC profiles (and uncertainties up to 45% for CDNC, and 24% for LWC)
- pyrcel results fall into range of variability and uncertainty of SYRSOC in summer case
- large difference between pyrcel and SYRSOC for winter case

- verify drizzle detection
- find more cases
- find closure?
Thank you for your attention!

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**Acknowledgement:** Funded by Irish Environmental Protection Agency through fellowship (2015-CCRP-FS.24), by European Union Horizon 2020 research and innovation programme under grant agreement No 654109 for ACTRIS-2, and by Science Foundation Ireland through research centre MaREI.