

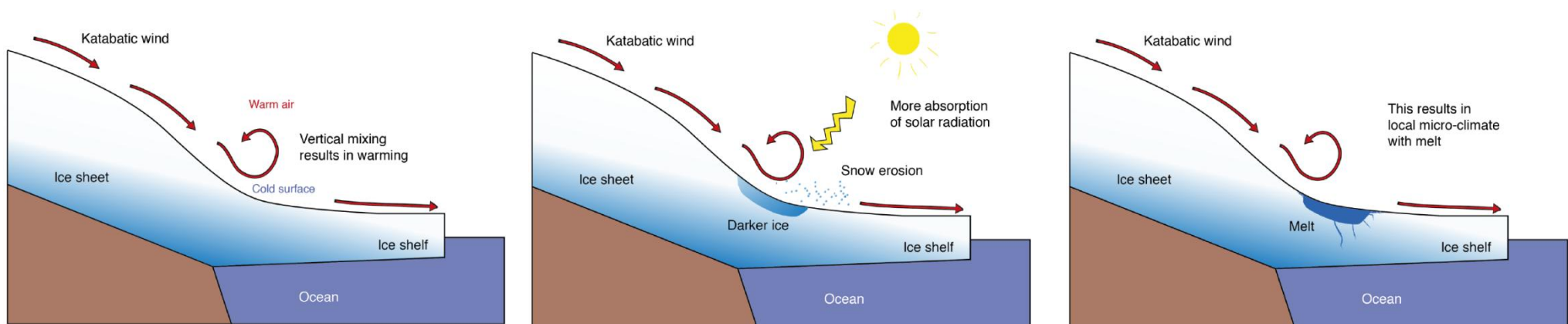
A new blowing snow scheme for CLM

Alexandra Gossart, Niels Souverijns, Charles
Amory, Claudio Scarchilli, Leo Van Kampenhout,
Bill Sacks, Nicole van Lipzig and Jan T.M.
Lenaerts

Introduction

Importance of blowing snow

- Displacement of particles : local SMB
- Sublimation of particles
- Blue ice and albedo feedback



Introduction

Two parts :

Observations : ceilometer at PE station

Session Block, A Seehorn

20.06.2018, 11:00 – 12:30

TE-3e - Remote sensing of polar regions

An New Algorithm to Detect Blowing Snow from Ceilometers in East Antarctica

A Seehorn

20.06.2018

11:30-11:45

Modelling : implementation of a blowing snow

Session Block, A Studio

21.06.2018, 14:00 – 15:30

AC-3a - High-Latitude Boundary Layers and Model Evaluation

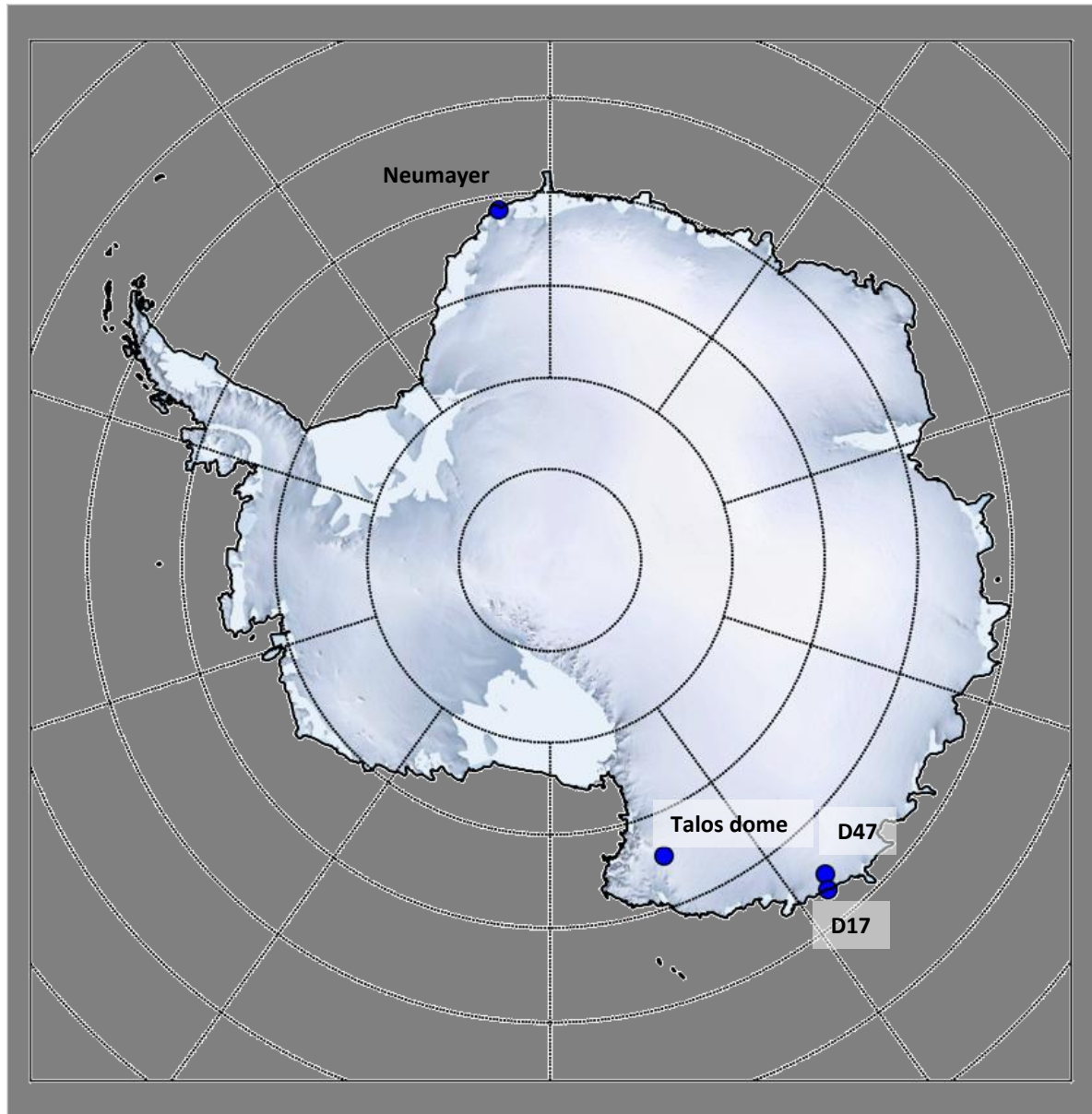
- A Long-term Hindcast Simulation with COSMO-CLM² over Antarctica

A Studio

21.06.2018

14:45-15:00

Material and methods



- NM : frequencies (2012 – 2013 - 2014)
- D47 : frequencies + transport (2010-2011)
- D17 : frequencies + transport (2013-2014)
- TD : frequencies + transport (2009)

Material and methods

Adaptations to the model to improve the snow pack

- Back porting changes from CLM5.0 to 4.5 (van Kampenhout et al., 2017)
- Density dependence on temperature and wind (van Kampenhout et al., 2017)
- Grain size dependent on wind speed and air temperature (van Kampenhout et al., 2017)
- Runoff/top snow temperature/albedo bug

Material and methods

Simple bulk model (Déry and Yau, 1999)

- Friction velocity (u_*) dependent on horizontal wind speed
- Blowing snow threshold based on air temperature

Material and methods

Simple bulk model (Déry and Yau, 1999)

- Friction velocity (u_*) dependent on horizontal wind speed only $\rightarrow$ dependence on snow density and other mobility parameters (Gallée 2001)

$$u_* = u_{*,t0} \exp\left(\frac{n}{1-n} + \frac{no}{1-no}\right)$$

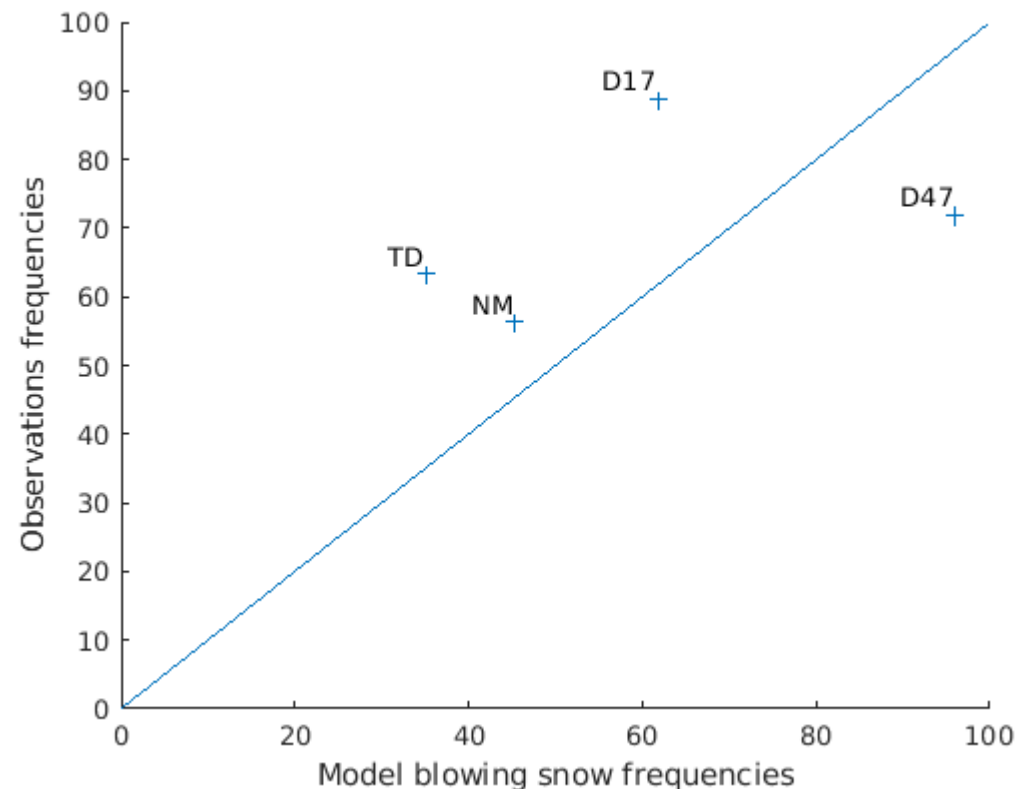
The diagram illustrates the equation for friction velocity u_* with three color-coded annotations:

- Orange circle:** $u_{*,t0}$ is annotated with an orange arrow pointing to the text: "Mobility of snow particles (dendricity and sphericity = 0,5) + drag coefficient for momentum (0,002)".
- Blue circle:** n is annotated with a blue arrow pointing to the text: "Snow density / ice density".
- Green circle:** no is annotated with a green arrow pointing to the text: "Porosity of fresh snow (300 kg/m³)".

Material and methods

Simple bulk model (Déry and Yau, 1999)

- Blowing snow threshold based on air temperature only



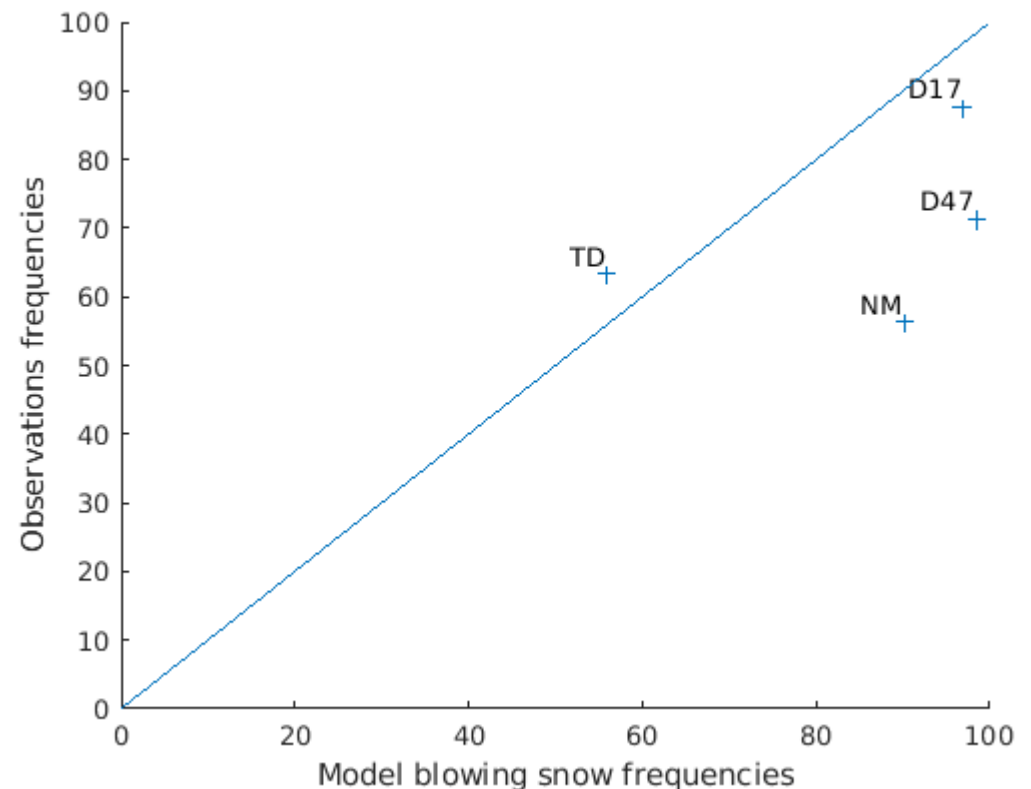
Material and methods

Simple bulk model (Déry and Yau, 1999)

- Blowing snow threshold based on air temperature only

Wind speed >

$A * t_{2m} + B * \text{snow density}$



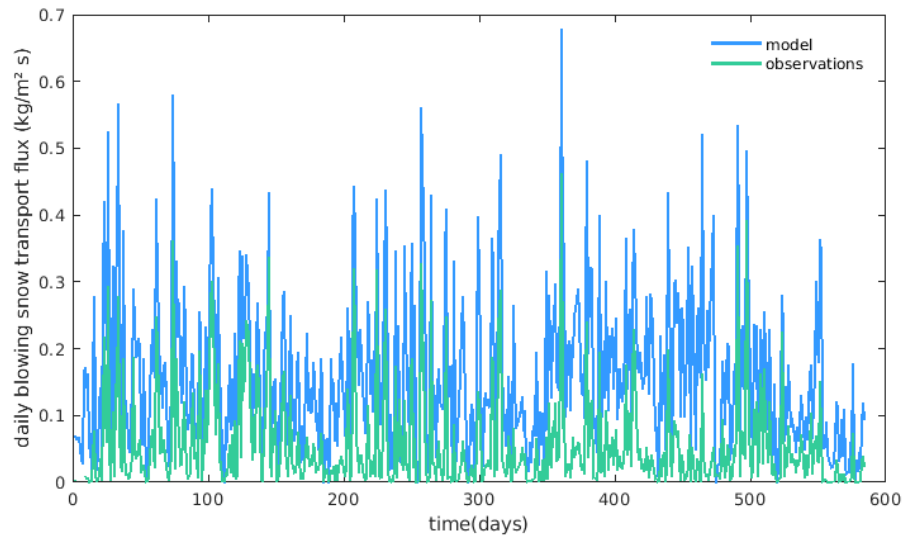
Material and methods

Simple bulk model (Déry and Yau, 1999)

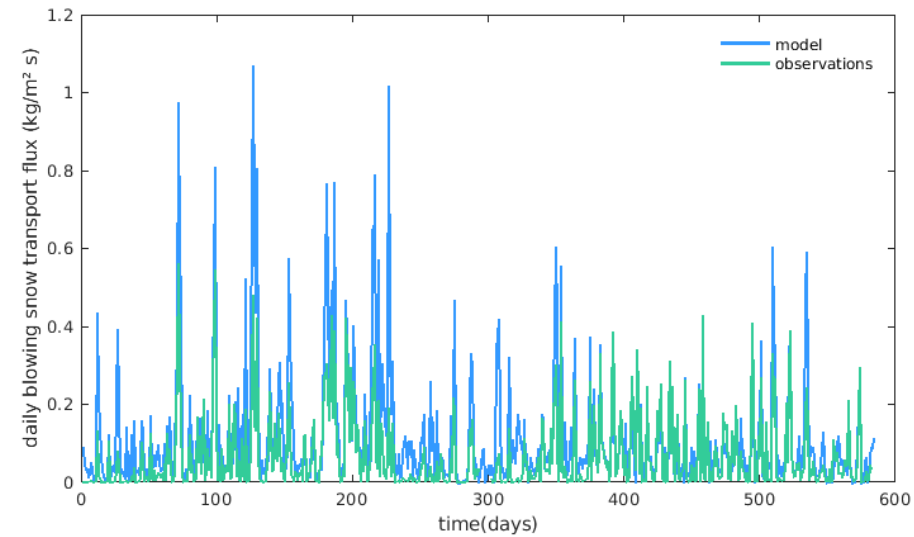
- Transport calculation as flux ($\text{kg/m}^2.\text{s}$)
- $A * \text{wind speed}^B$

Material and methods

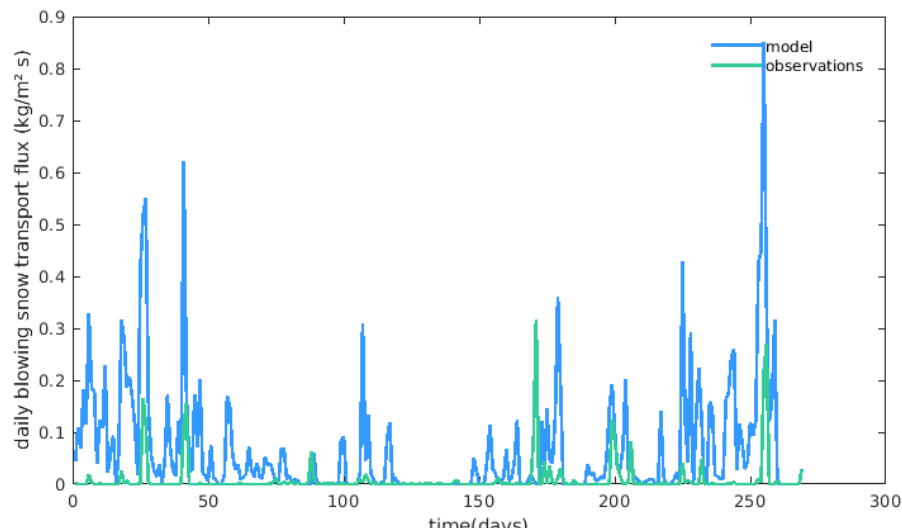
D47



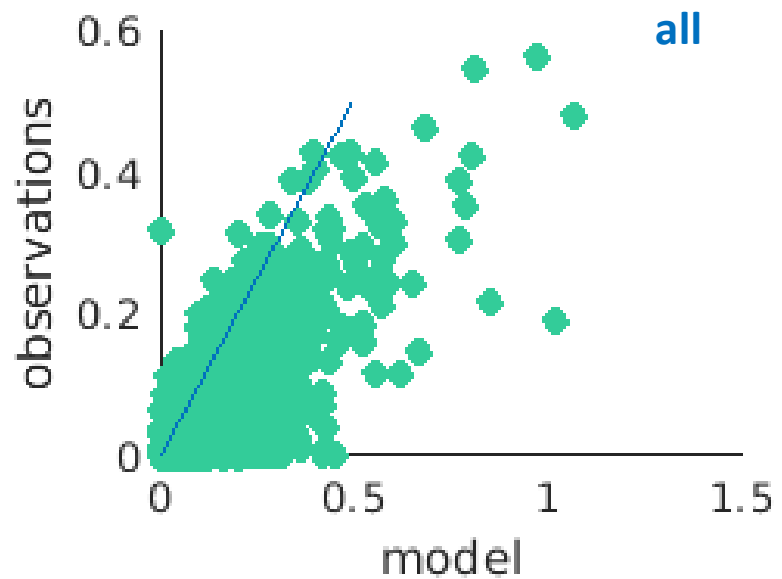
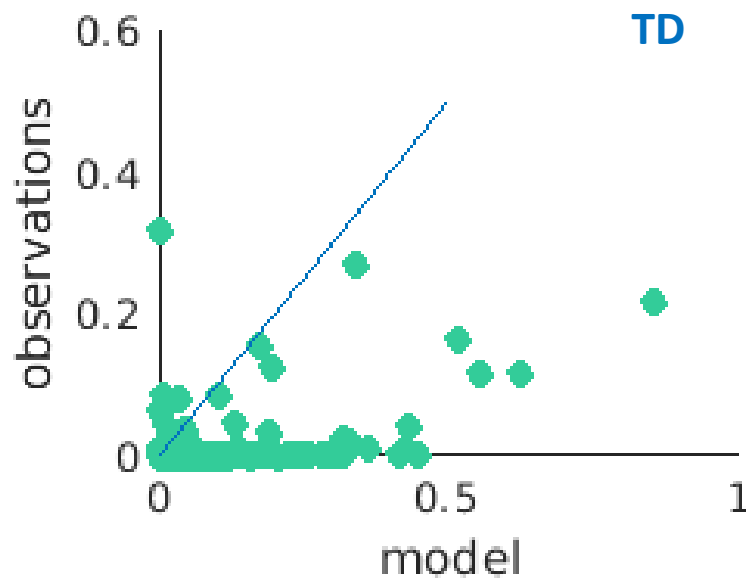
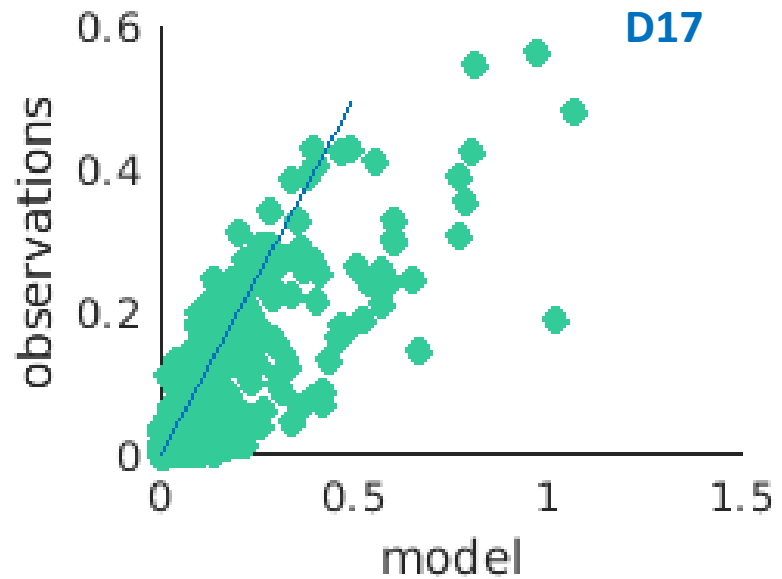
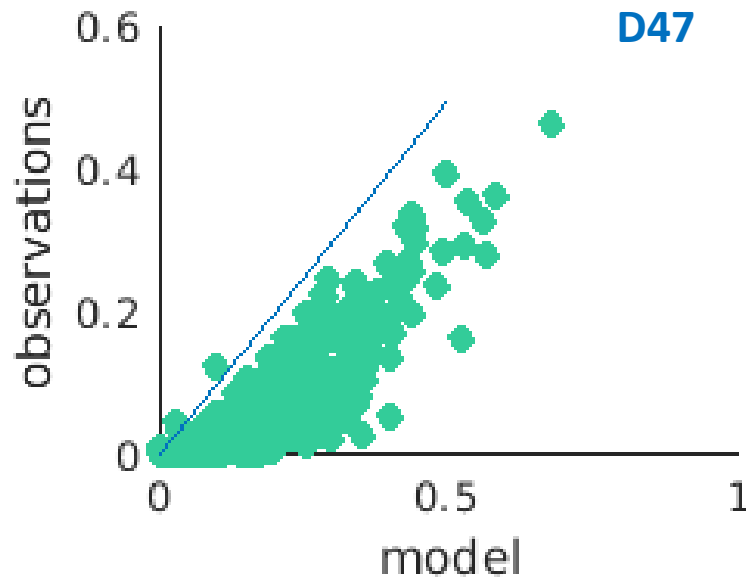
D17



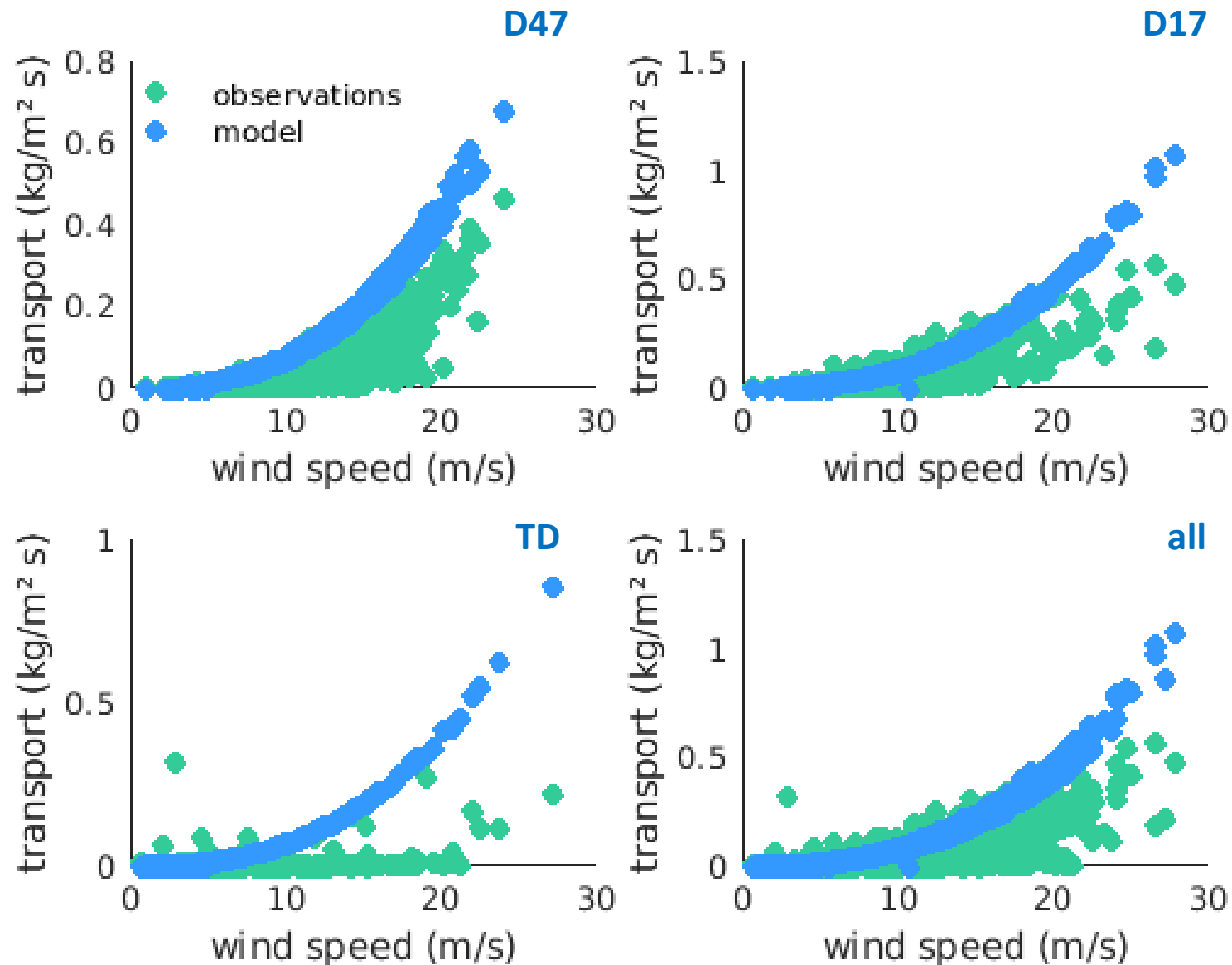
TD



Material and methods



Material and methods



Future work

- 1) Blowing snow sublimation
- 2) Add the routine in the coupled COSMO-CLM² model
- 3) Simulate blue ice