

# JULES performance in ESM-SnowMIP

Richard Essery and Cécile Ménard

School of GeoSciences, University of Edinburgh



# ESM-SnowMIP



## Climate and Cryosphere

*Understanding the changing cryosphere and its climate connections*



search...

a core project of



### ESM-SnowMIP

- About
- Meetings
- Downloads

## Earth System Model-Snow Model Intercomparison Project (ESM-SnowMIP)

Snow is an essential component of the Earth System. As both a permanent and an intermittent component of the cryosphere, it interacts with the atmosphere and the surfaces it covers (land, ice, sea ice) and it is one of the principal sources of feedbacks within the climate system. As an outcome of the Tromsø 2013 Workshop the WCRP/CliC Initiative for a ESM-SnowMIP intercomparison programme is a contribution to the WCRP Grand Challenge Melting Ice & Global Consequences. The current strengths and weaknesses of snow models used in ESM and GCM must be assessed in order to provide guidelines for their improvement.

[Why is a large-scale integrated study of snow in the climate system timely?](#)

[ESM-SnowMIP: Building on a strong legacy](#)

[Design of ESM-SnowMIP](#)

[Call for Participation - ESM-SnowMIP](#)

[Related observational activities](#)

[Reference sites: Site description and instructions for simulations](#)

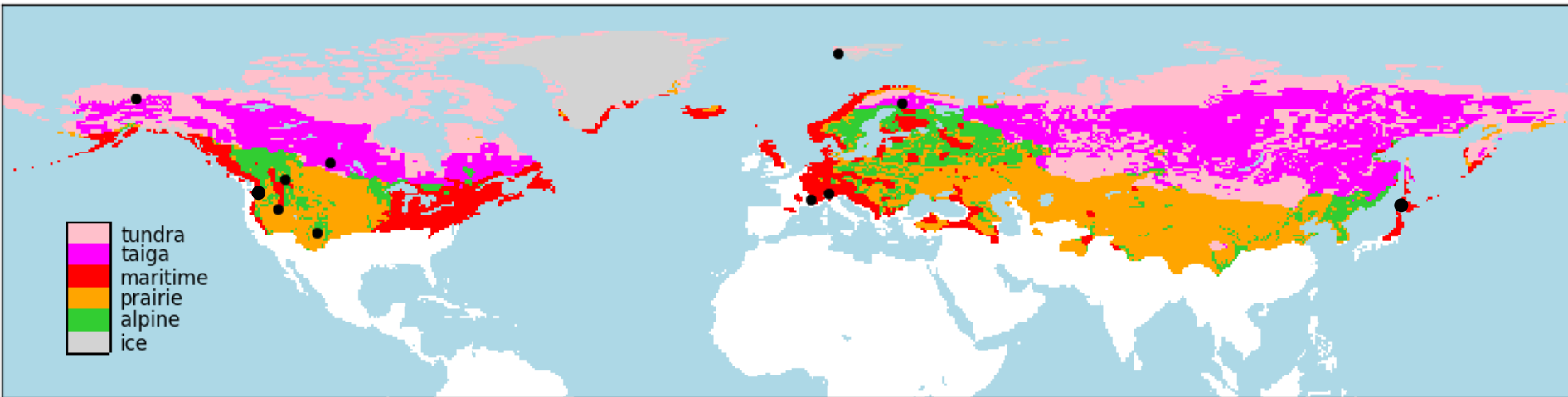
[ESM-SnowMIP workshop in San Francisco, Dec 10, 2016 \(prior to AGU\)](#)

[In memoriam: Andrew Slater](#)

# Intercomparison projects with snow components

Extent \ Forcing	Coupled	Uncoupled
Global	AMIP CMIP ESM-SnowMIP	GSWP WaterMIP ESM-SnowMIP
Regional	CORDEX ReSCUES	PILPS2e Rhône-Agg ReSCUES
Local	GABLS	PILPS2d SnowMIP-1 and -2 ESM-SnowMIP

# ESM-SnowMIP reference sites



Map: Sturm et al. (1995) seasonal snow cover classification

- BERMS pine, Saskatchewan
- BERMS spruce, Saskatchewan
- BERMS aspen, Saskatchewan
- Col de Porte, France
- Reynolds Creek, Idaho
- Sapporo, Japan
- Senator Beck, Colorado
- Sodankylä, Finland
- Swamp Angel, Colorado
- Weissfluhjoch, Switzerland

+ additional glacier, tundra and ice sheet sites to follow

# ESM-SnowMIP models

## **ESM land surface schemes**

BCC\_AVIM

CABLE

CLASS

CLM

CoLM

HTESSEL

ISBA

JULES

JSBACH

MATSIRO

ORCHIDEE

## **Snow physics models**

Crocus

SNOWPACK

## **Ensemble models**

ESCROC

FSM

Noah-MP

SUMMA

## **Hydrology models**

AMUNDSEN

MAPS

SMAP

SPONSOR

SRGM

SWAP

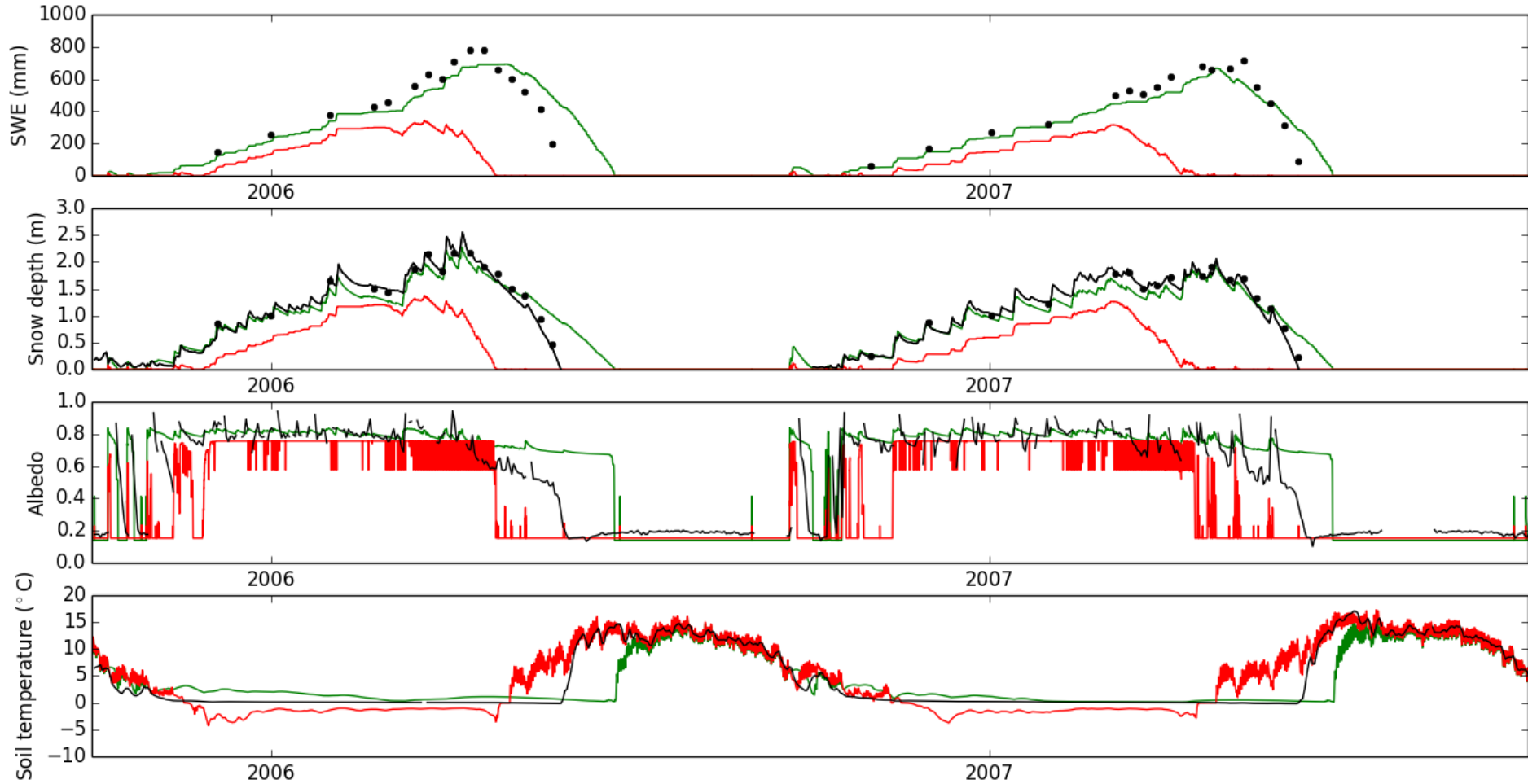
VEG3D

# JULES performance in ESM-SnowMIP

e.g. 2 winters at Swamp Angel, Colorado

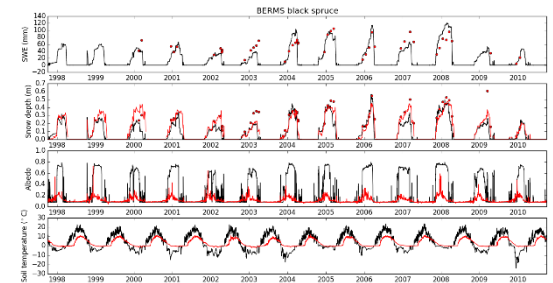
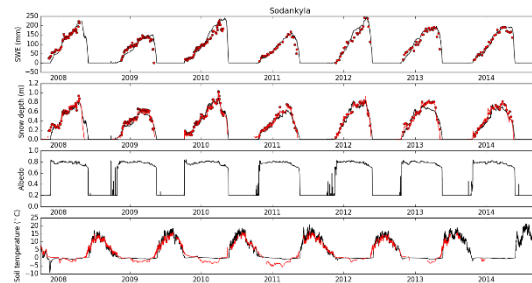
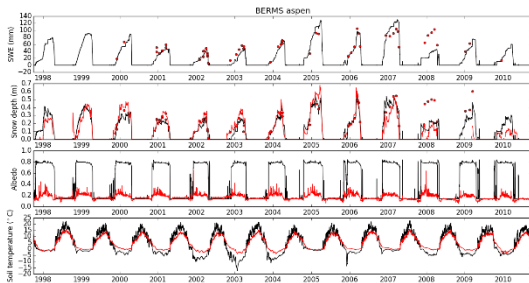
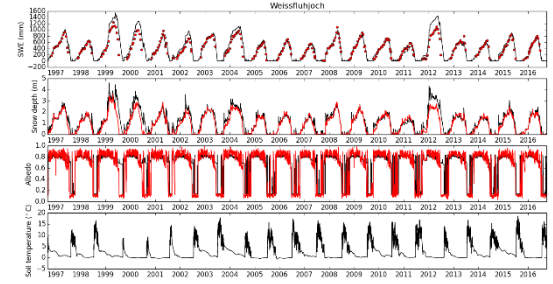
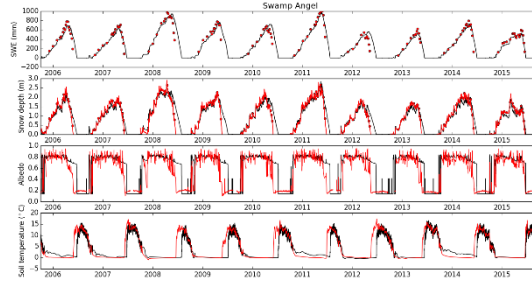
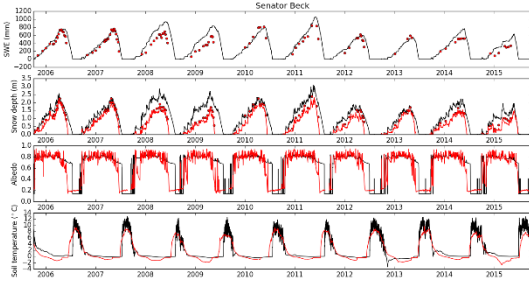
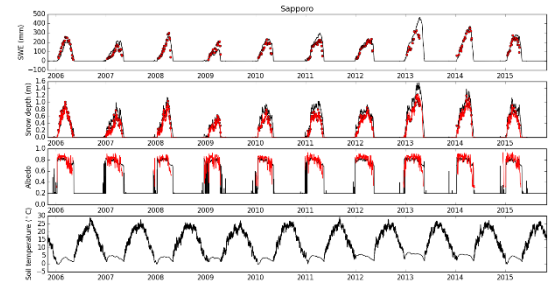
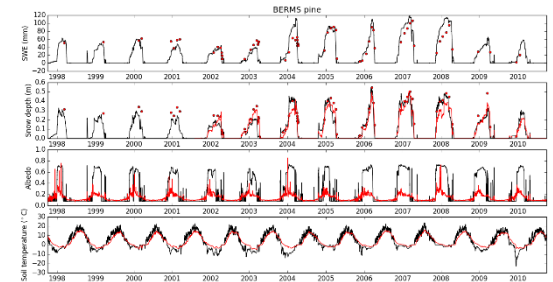
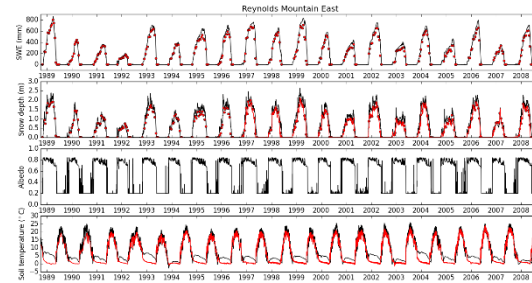
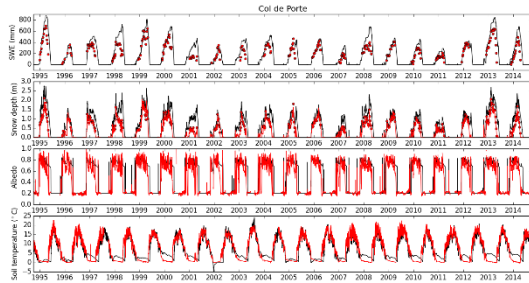
JULES `nsmax = 0`, `l_spec_albedo = .false`.

JULES `nsmax = 3`, `l_spec_albedo = .true`.



# JULES performance in ESM-SnowMIP

7-20 years and up to 5 evaluation variables at  
10 sites →  
>  $10^5$  daily evaluation data points

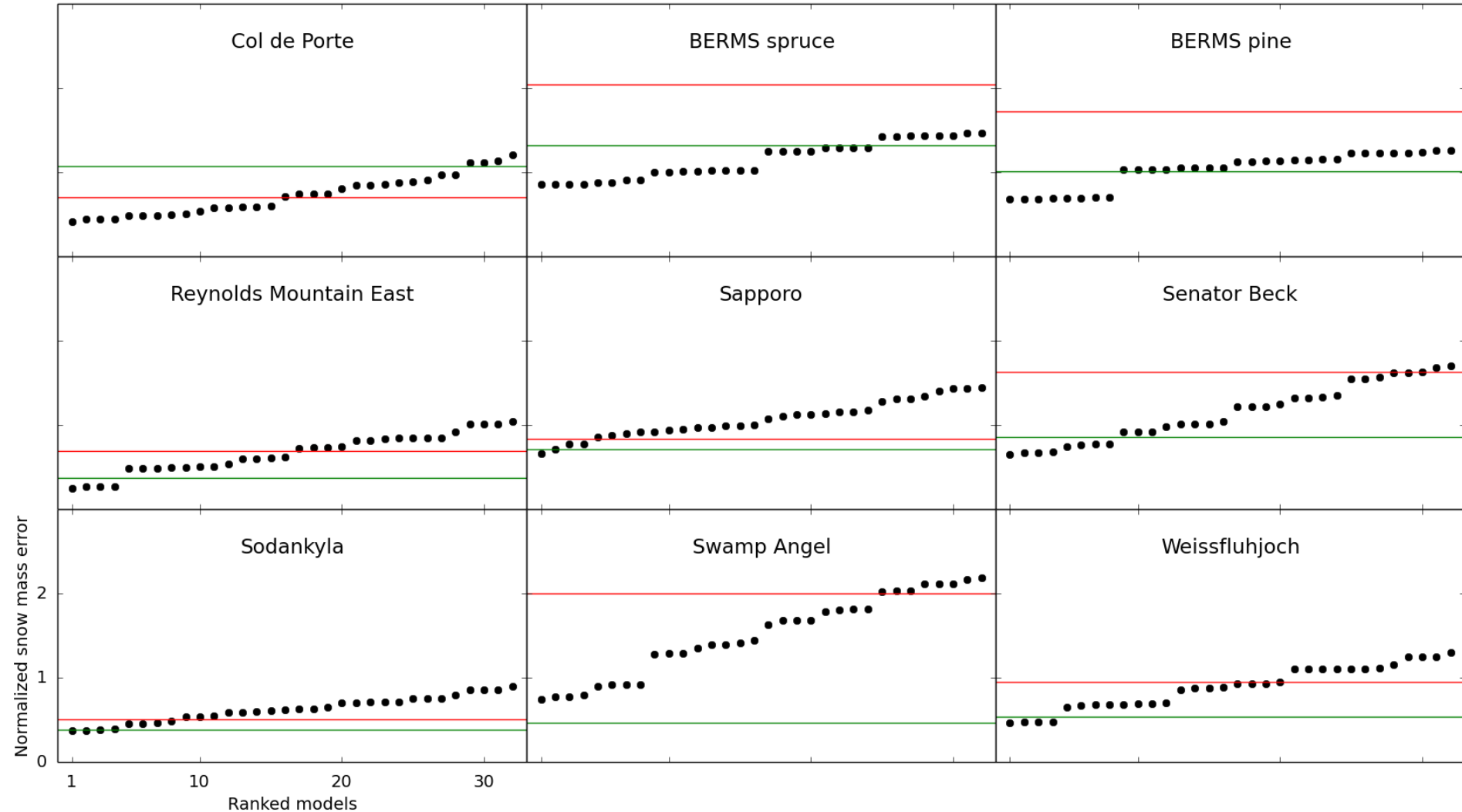


# JULES performance in ESM-SnowMIP

ranked snow mass errors in FSM 32-member ensemble

JULES `nsmax = 0`, `l_spec_albedo = .false.`

JULES `nsmax = 3`, `l_spec_albedo = .true.`





# ESM-SnowMIP aims

- identify gross model errors and provide data for model improvement
- benchmark models – what is the best model performance that can be obtained consistent with information and errors in driving and evaluation data?
- understand model surface mass balance in terms of surface energy balance – right answers for the right reasons
- use reference site simulations to understand model behaviour in CMIP6 and GSWP3