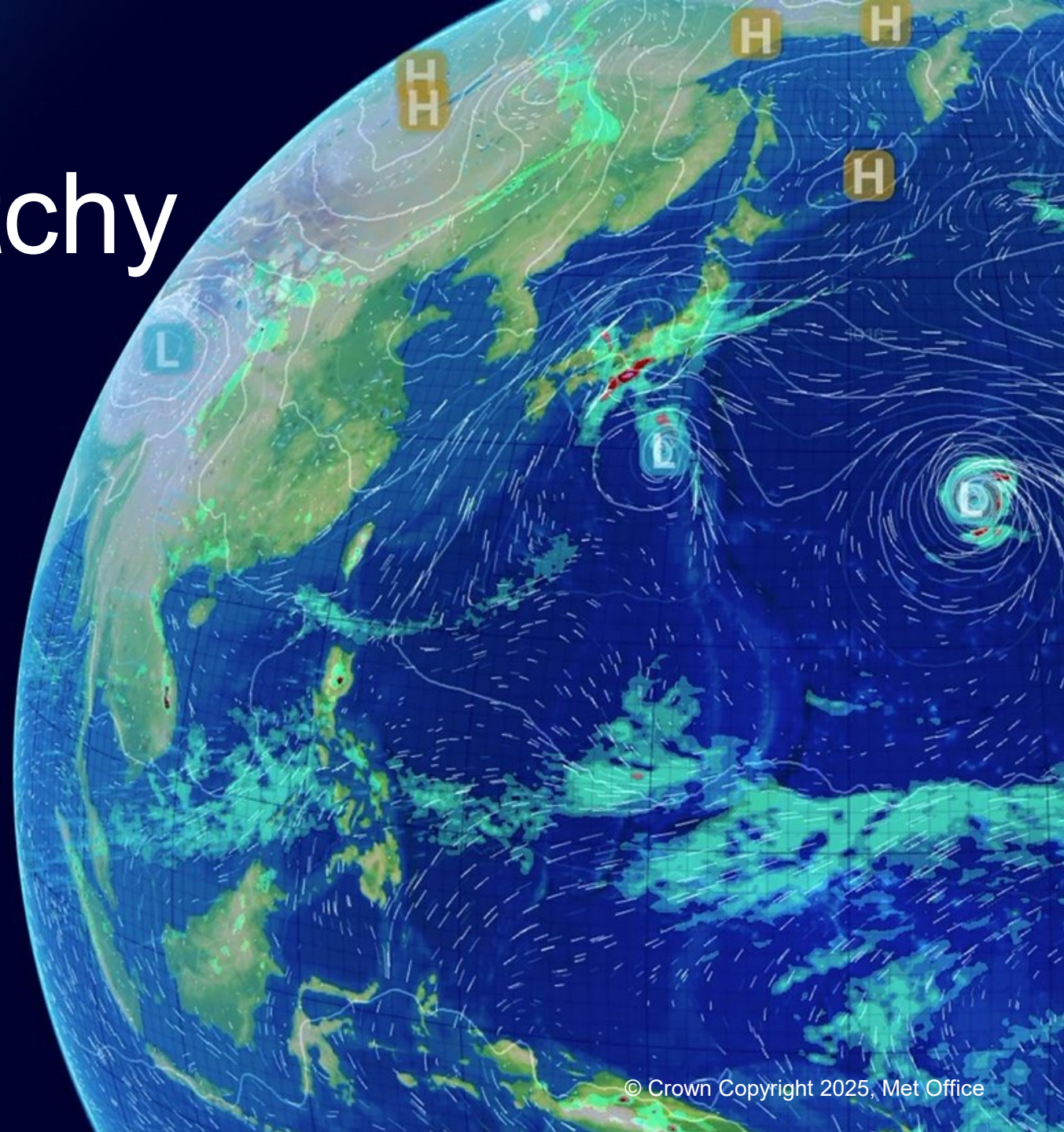


JULES needs patchy snow

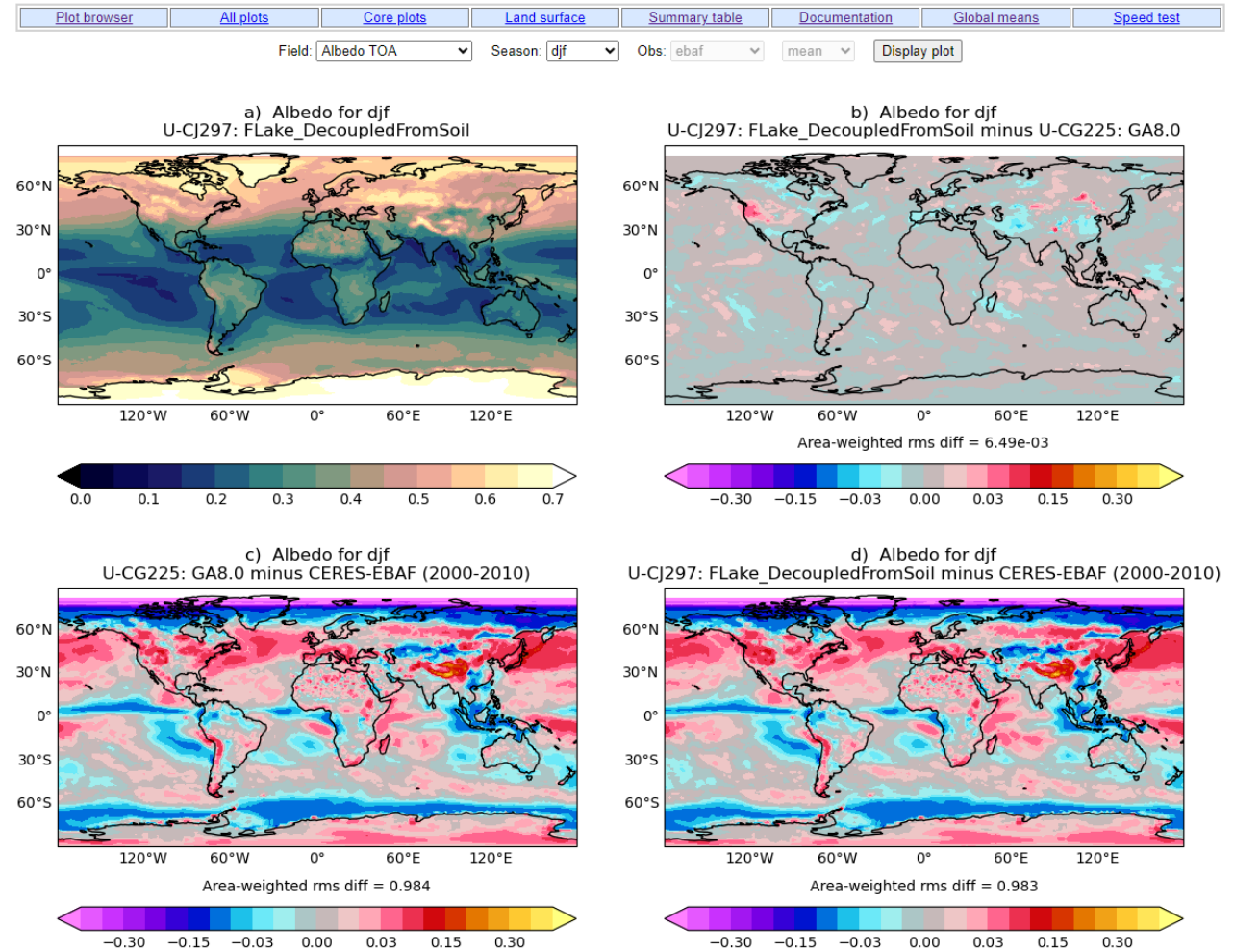
Helen Johnson

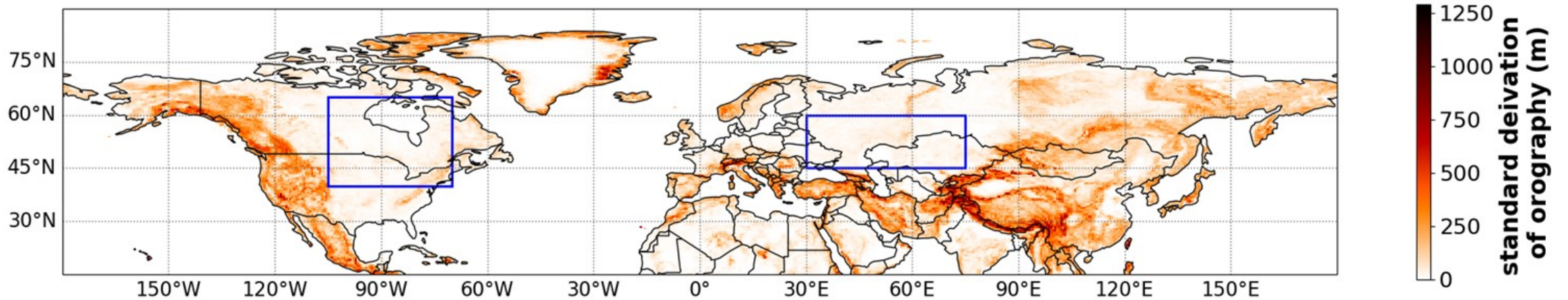
September 2025



Assessing Snow albedo

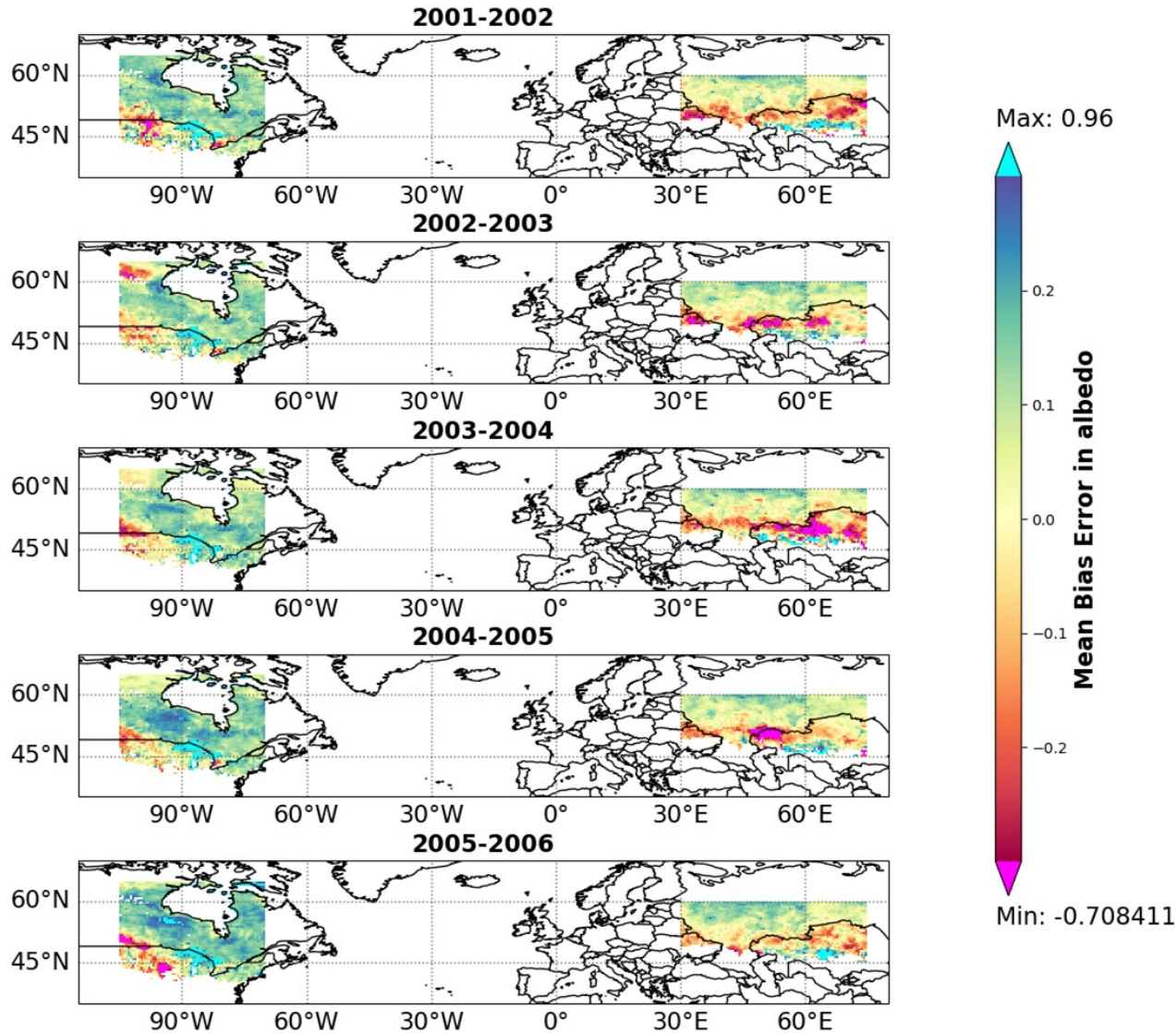
- Snow albedo is an important property to get right because it affects the entire energy balance of the snow pack.
- Our typical methods of validating model albedo don't distinguish snow covered from snow free surfaces and sometimes don't even distinguish cloud covered from clear sky albedo.



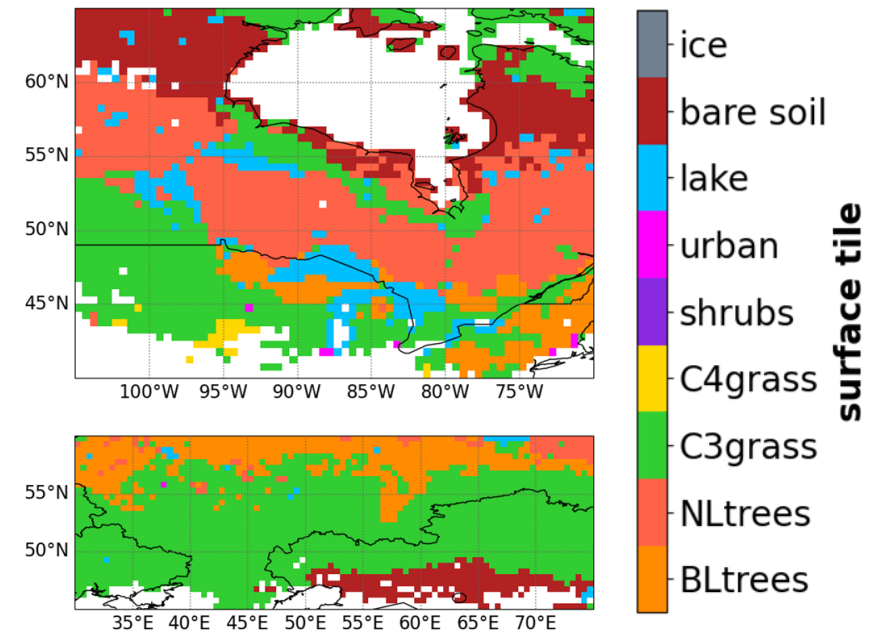


- Standalone JULES simulations, with GL9 configuration, forced by WFDEI to isolate snow processes on the ground from any potential atmospheric model biases in precipitation or air temperature.
- Currently there is no mechanism for specifying orography in standalone JULES so `I_mask_snow_orog` option has no effect.
- Also, WFDEI driving data is expected to be less accurate in mountainous and high latitude areas due to sparse and uneven distribution of rain gauges.
- Therefore chose to focus on relatively flat regions where standalone JULES should still behave in a similar way to coupled GA/GL9.

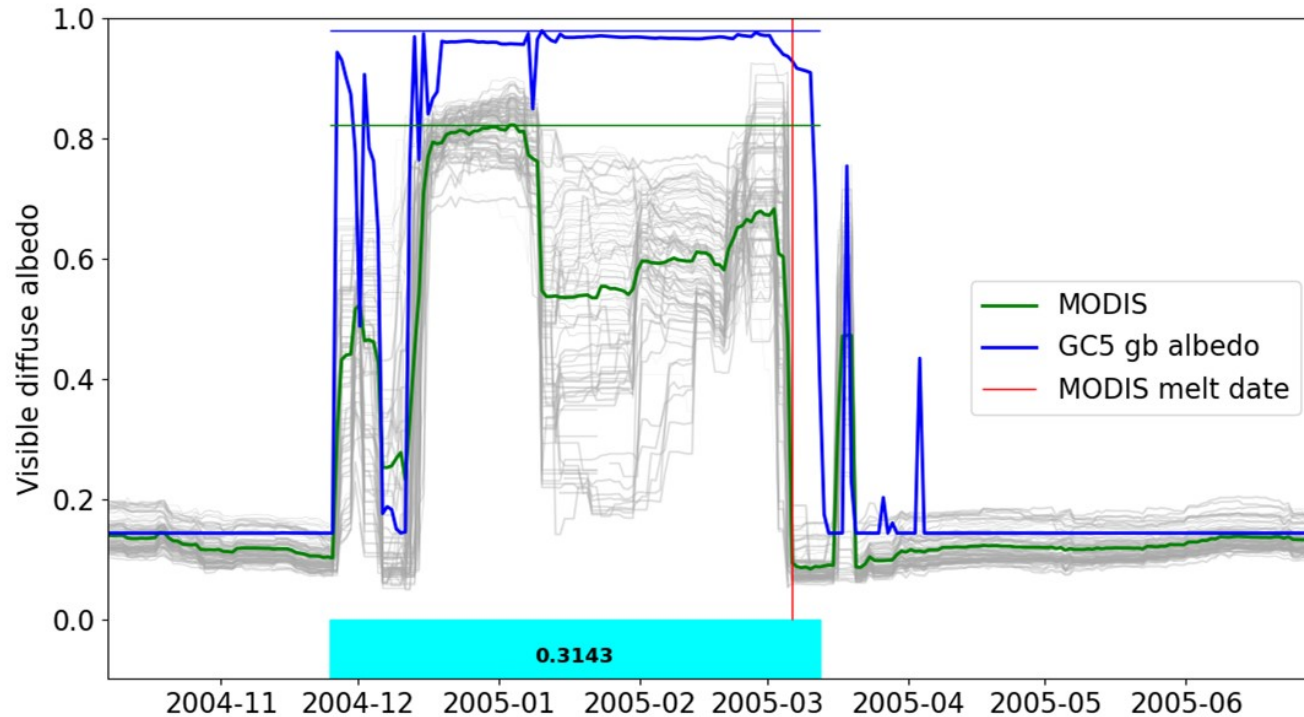
Albedo error compared to satellite



- Using MODIS MCD43C albedo product
- Calculate longest snow covered period for each gridbox
- Compare the model to the satellite product just during that period
- Differences are model minus satellite so **blue = model overpredicting** albedo, **red = underpredicting**.

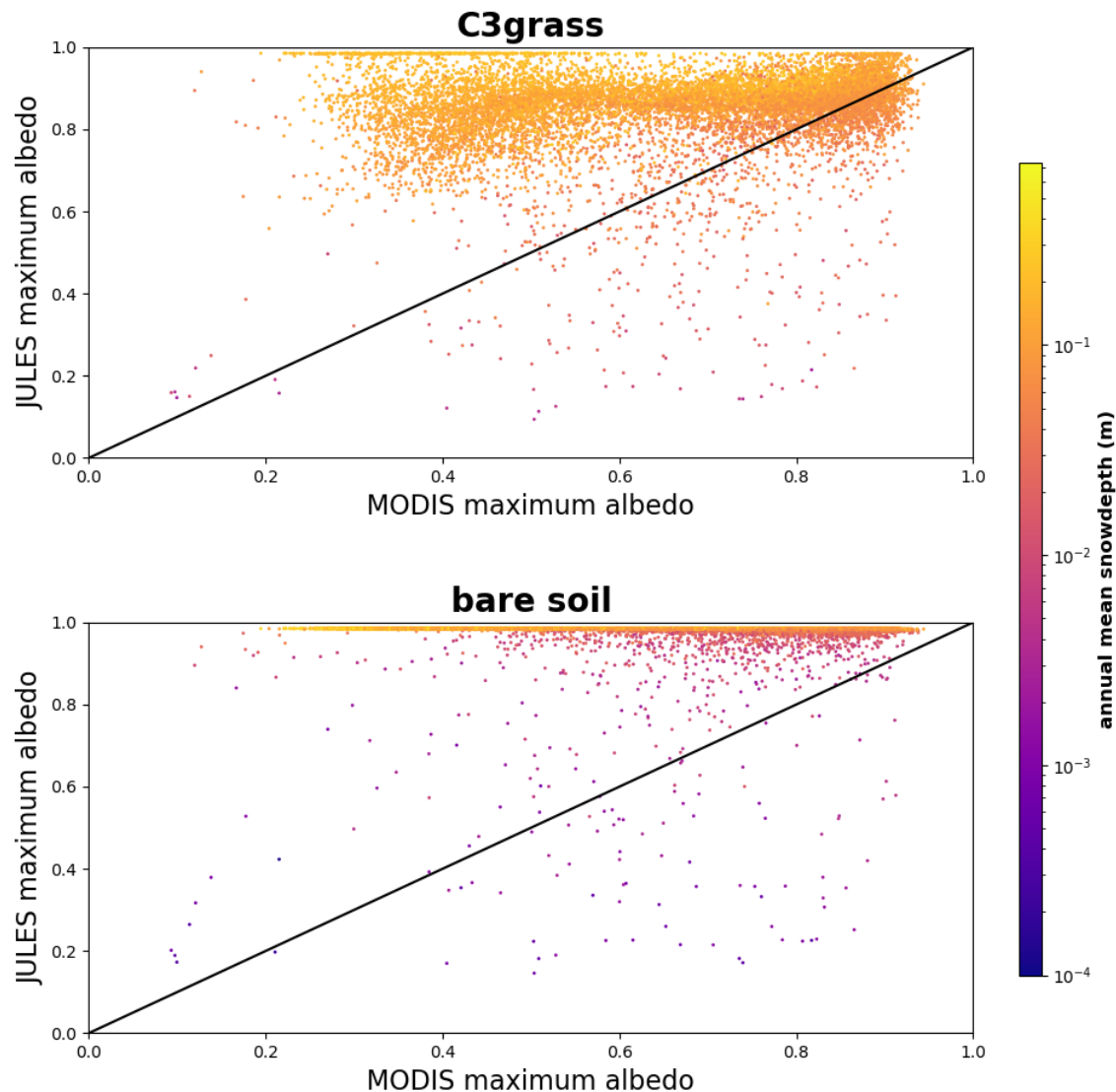


Single point timeseries



- The MODIS gridbox average value is made up of 100 satellite pixels (grey lines)
- Early in the snow season these pixels are in good agreement but as snow starts to melt there is a large spread in values across the gridbox that indicate varying degrees of partial snow cover.

Model vs. satellite scatter plots



JULES allows for different amounts of snow on different surface tiles and partial exposure of vegetation above a snow surface but these are the only mechanisms JULES currently has to represent partial snow cover within a gridbox.



Summary:

- We need to be analysing snow covered albedo and snow free albedo separately when evaluating model performance.
- Evaluated snow albedo in GL9 configuration. There are some very large biases, both positive and negative, compared to MODIS satellite albedo.
- JULES's inability to represent patchy snow is a major contributor to the positive biases.