Project: **909**

Project title: **Learning on cloud brightening under risk and uncertainty: Whether, when and how to do a field experiment (LEAC)**

Project lead: **Johannes Quaas**

Report period: **1.1.2018 – 31.12.2018**

In the reporting period, an idealised setup of regional climate engineering (Quaas et al., 2016) has been implemented that would aim to mitigate climate change locally (in the chosen example, North America; see also report for 2017 and request for 2018) by cloud modification within the MPI-ESM (Girogetta et al., 2013). The idea was to test the hypothesis that regional climate engineering is feasible without significant climate modifications outside the target area. However, the simulations conducted in the reporting period showed clear climate responses outside the target area, especially Arctic warming (Dipu et al., in preparation).

The teleconnection between local cooling and the simulated Arctic warming was analysed in the simulations (Fig. 1): a clear pricture emerged in which an anomalous circulation was documented that led to anomalous heat transport into the Arctic region. Besides this documented teleconnection, further a clear impact on Tropical precipitation was distinguished that also could be traced back to dyanmics changes (Dipu et al., in preparation).

References

Dipu S., J. Quaas, *M. Quaas, W. Rickels, J. Mülmenstädt, and O. Boucher, Limited-area climate engineering: Climate response outside the target area, in preparation for Environ. Res. Lett.*

Giorgetta, M., Jungclaus, J., Reick, C., Legutke, S., Bader, J., Böttinger, M., Brovkin, V., Crueger, T., Esch, M., Fieg, K., Glushak, K., Gayler, V., Haak, H., Hollweg, H.-D., Ilyina, T., Kinne, S., Kornblueh, L., Matei, D., Mauritsen, T., Mikolajewicz, U., Mueller, W., Notz, D., Pithan, F., Raddatz, T., Rast, S., Redler, R., Roeckner, E., Schmidt, H., Schnur, R., Segschneider, J., Six, K., Stockhause, M., Timmreck, C., Wegner, J., Widmann, H., Wieners, K.-H., Claussen, M., Marotzke, J. & Stevens, B., Climate and carbon cycle changes from 1850 to 2100 in MPI-ESM simulations for the coupled model intercomparison project phase 5. J. Adv. Model. Earth Syst., 5, 572-597, doi:10.1002/jame.20038, 2013.

Quaas, J.*, M. F. Quaas, O. Boucher, and W. Rickels, Regional climate engineering by radiation management: Prerequisites and prospects, Earth's Future, 4, 618-625, doi:10.1002/2016EF000440, 2016.*

Figures

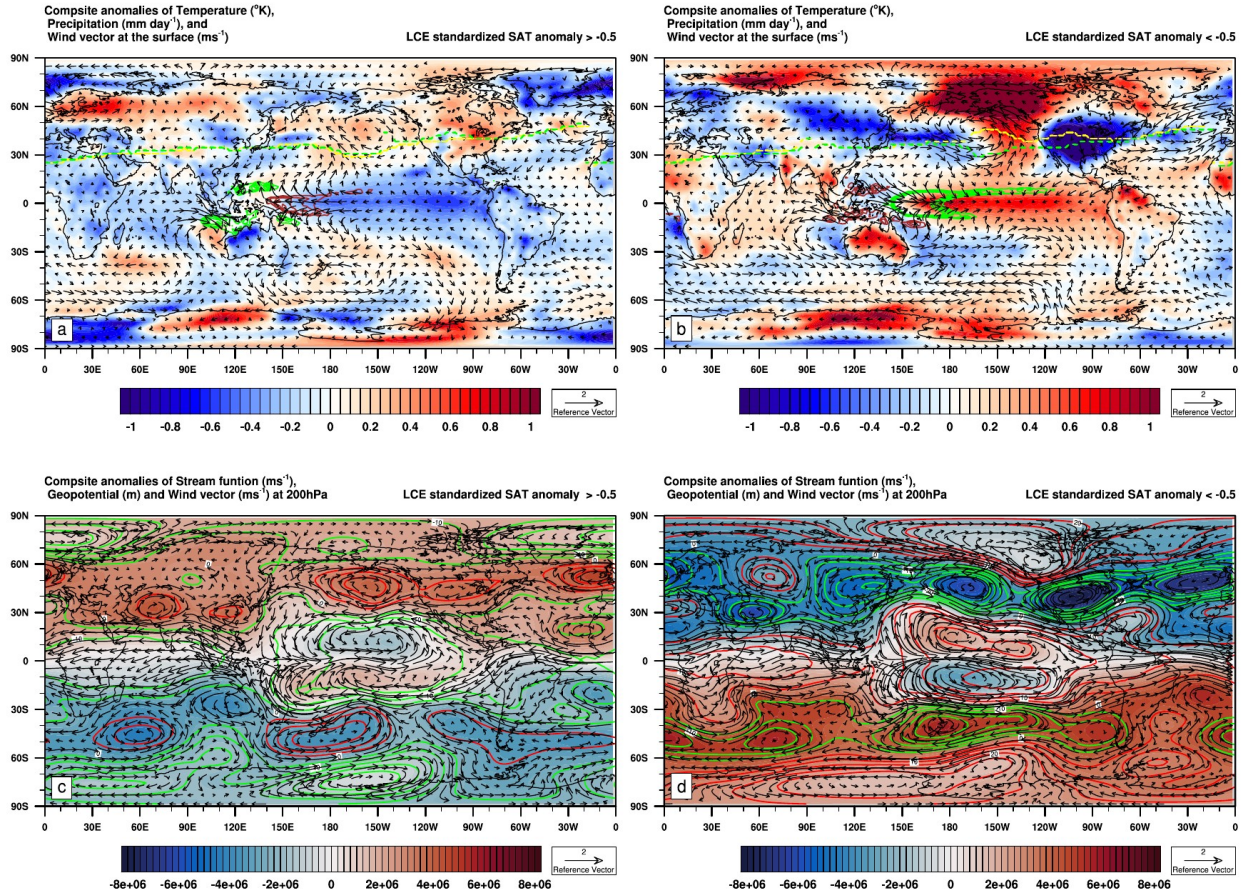

Fig. 1. Composite anomalies of (a) surface air temperature (SAT), (shaded), precipitation (green contours are for positive and brown contours for negative anomalies (contour,-2.0 to 2.0 mm d^{-1}, with spacing 0.25 mm d^{-1}), and wind vector at the surface for conditions in which the standardized SAT in the LCE region > -0.5, (b) as (a) but for conditions in which the standardized SAT in the LCE region < -0.5. The green (experiment) and yellow (control) dotted lines represent the core of the jet stream (max. zonal wind between 300 and 200 hPa). (c) Composite anomalies of the stream function (shaded), geopotential height (green contours are for positive and red contours for negative anomalies) and wind vector at 200 hPa for conditions in which the standardized SAT in the LCE region > -0.5, and (d) as (a), but for conditions in which the standardized SAT in the LCE region < -0.5.