WMO WGSIP INITIATIVE:

"SNOWGLACE":

An international project aimed at quantifying snow initialisation impact on subseasonal-to-seasonal forecasts

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The aim of this initiative is to evaluate how individual state-of-the-art dynamical forecast systems vary in their ability to extract forecast skill from snow initialization. The modeling strategy follows the one develop during previous initiatives, GLACE 1 and 2 (e.g. Koster et al., 2011).

Experiments : **multi-model** subseasonal-to-seasonal simulations covering over at least a decade, but preferably several decades, with either realistic or else unrealistic (climatological, scrambled,…) snow conditions, and start dates in fall and spring

- Effect of autumn Eurasian snowpack on boreal winter circulation (incl. NAO and AO) : single-model study but no multi-model intercomparison yet
- **Impact of snowpack over the Himalaya-Tibetan Plateau (HTP) on S2S and seasonal timescales**

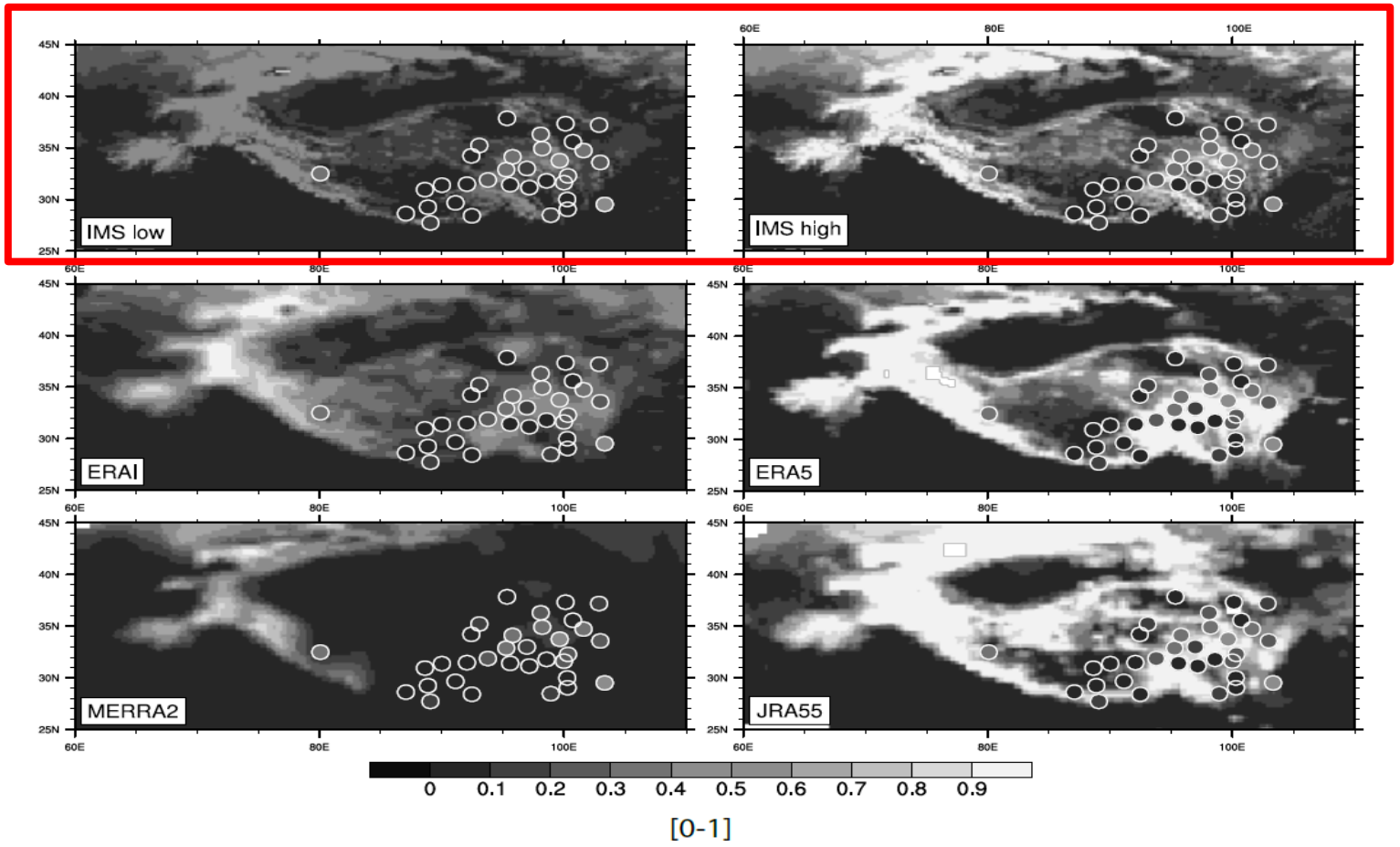
REFERENCES:

- Li, F., Y. Orsolini, N. Keenlyside, M.-L. Shen, F. Counillon, Y. Wang, Impact of snow initialisation in subseasonal-to-seasonal winter forecasts with the Norwegian Climate Prediction Model , JGR-Atmosphere special issue on Bridging Weather and Climate: Subseasonal-to-Seasonal (S2S) Prediction, vol. 124, 2019
- Jeong, J.H., H.W. Linderholm, S.-H. Woo, C. Folland, B.-M. Kim, S.-J. Kim and D. Chen (2013), Impact of snow initialization on subseasonal forecasts of surface air temperature for the cold season, J. Clim., 26, 1956-1972
- Orsolini Y., M. Wegmann, E. Dutra, Boqi Liu, G. Balsamo, K. Yang, P. de Rosnay, C. Zhu, W. Wang, R. Senan: Evaluation of snow depth and snow-cover over the Tibetan Plateau in global reanalyses using in-situ observations and satellite remote sensing products, The Cryosphere, 13, 2221–2239, 2019.

UPDATE October 2020 !

Comparison of snow in modern re-analyses, satellite (IMS product) and station data over the Tibetan Plateau

Many re-analyses considerably over-estimate SCF and snow depth over Tibet Plateau compared to satellite obs (red square)



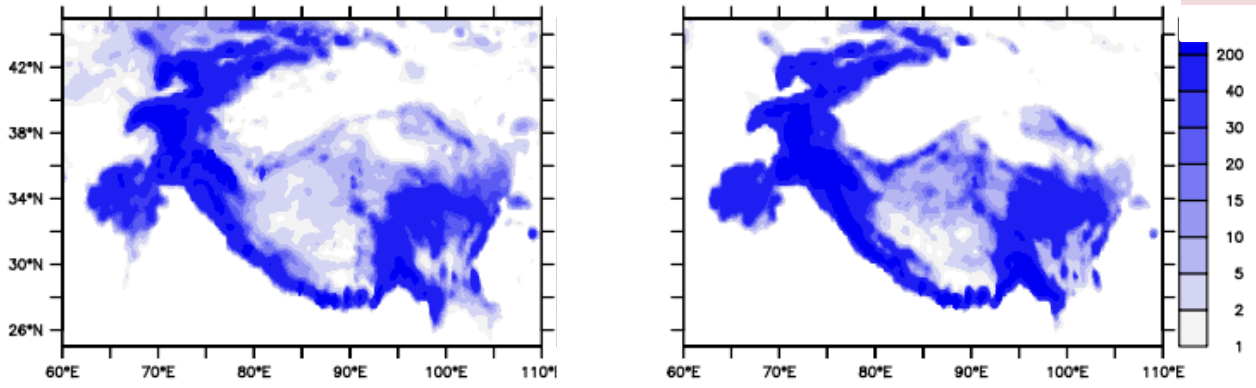
snow cover fraction (SCF) JANUARY

REFERENCE:

- Orsolini Y., M. Wegmann, E. Dutra, Boqi Liu, G. Balsamo, K. Yang, P. de Rosnay, C. Zhu, W. Wang, R. Senan: Evaluation of snow depth and snow-cover over the Tibetan Plateau in global reanalyses using in-situ observations and satellite remote sensing products, The Cryosphere, 13, 2221–2239, 2019.

Improved (test) snow analyses to initialize seasonal forecast model

SWE

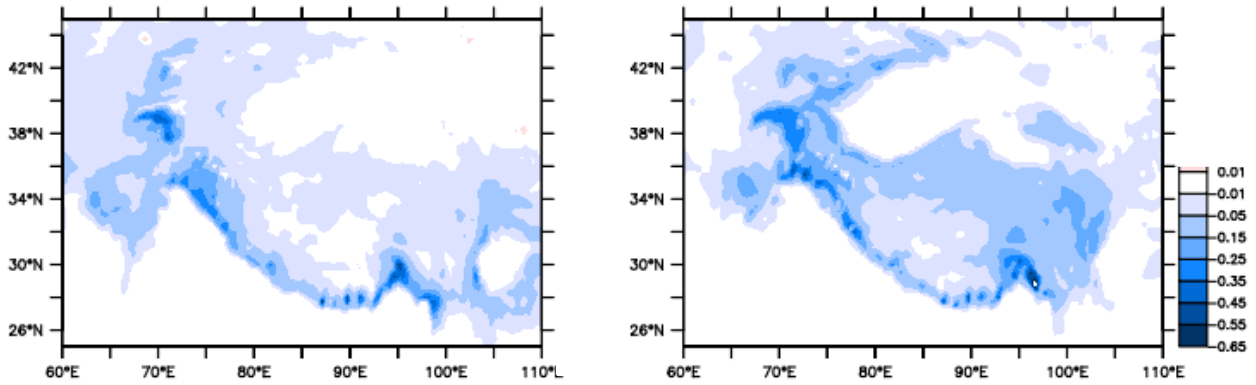


(a) SWE (mm) DJF

(b) SWE (mm) MAM

(CTRL) "ECMWF operational"

Decrements (m)



(a) SWE increments (m) DJF

(b) SWE increments (m) MAM

Due to IMS DA (TEST)

Negative!

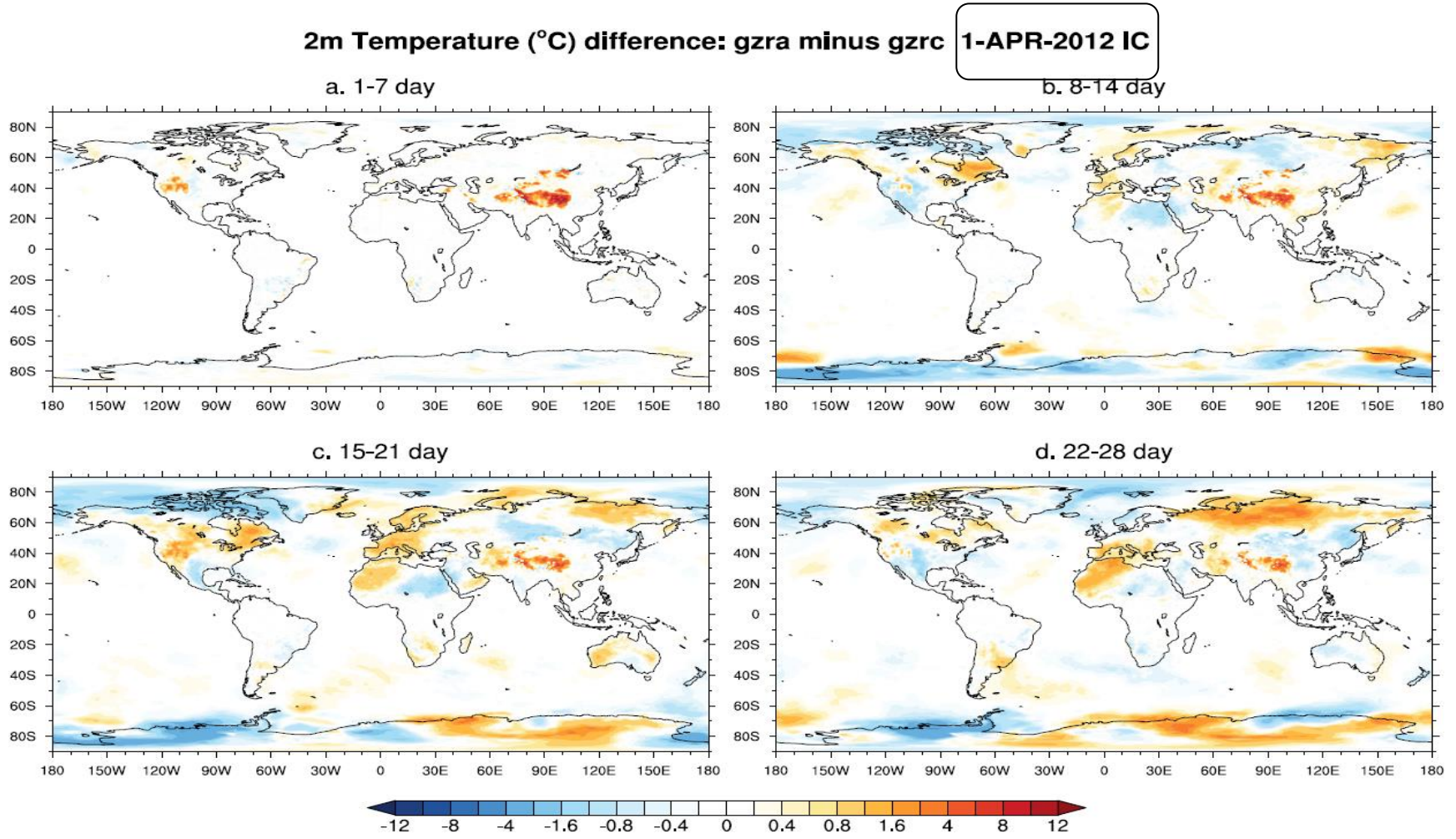
Snow Water Equivalent (mm) : seasonal means

Test period : year 2012 (also 2018 in progress)

ECMWF

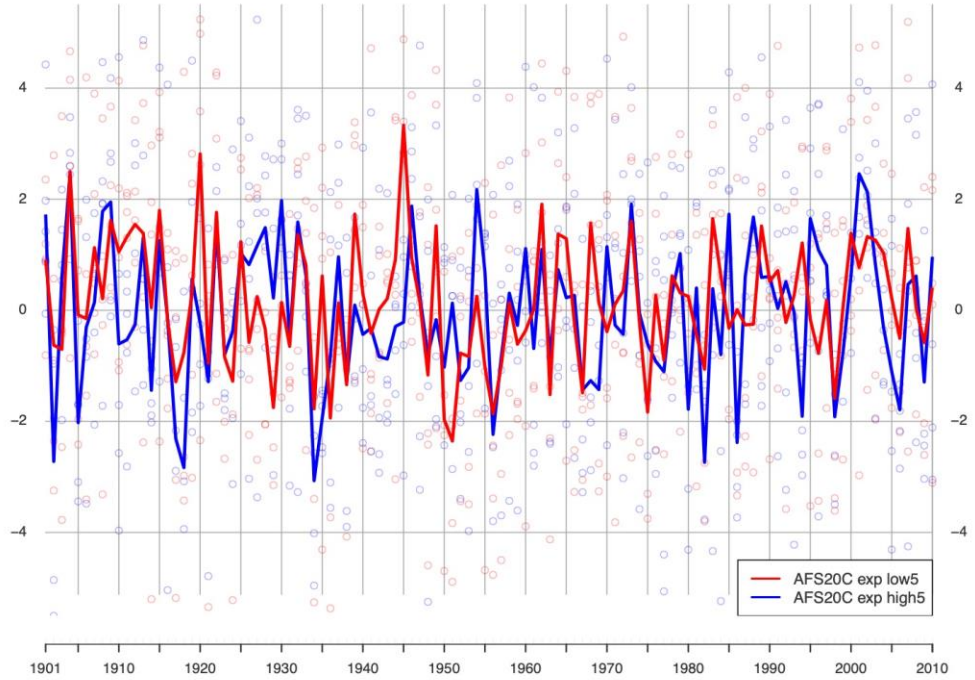
Collaboration with P. de Rosnay, R. Senan, G. Balsamo (ECMWF)

Impact of improved snow initialization on T2m (ECMWF seasonal forecast model)



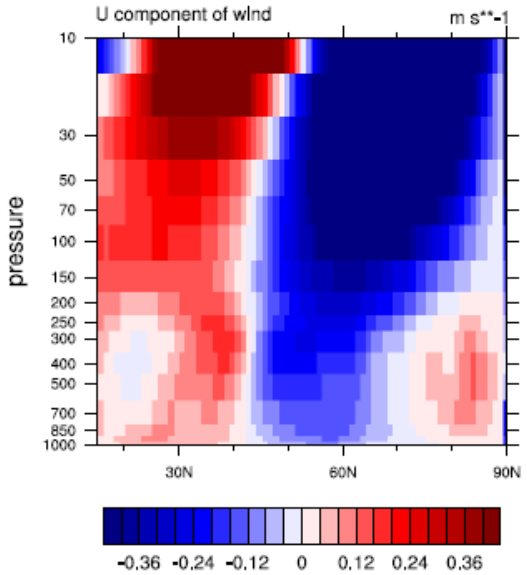
<u>Key questions</u> : what is impact on wave-trains propagating from Atlantic through Eurasia in spring , on Indian monsoon onset, …

Impact of snow initialization : historical seasonal forecast from ECMWF (ASF-20C)



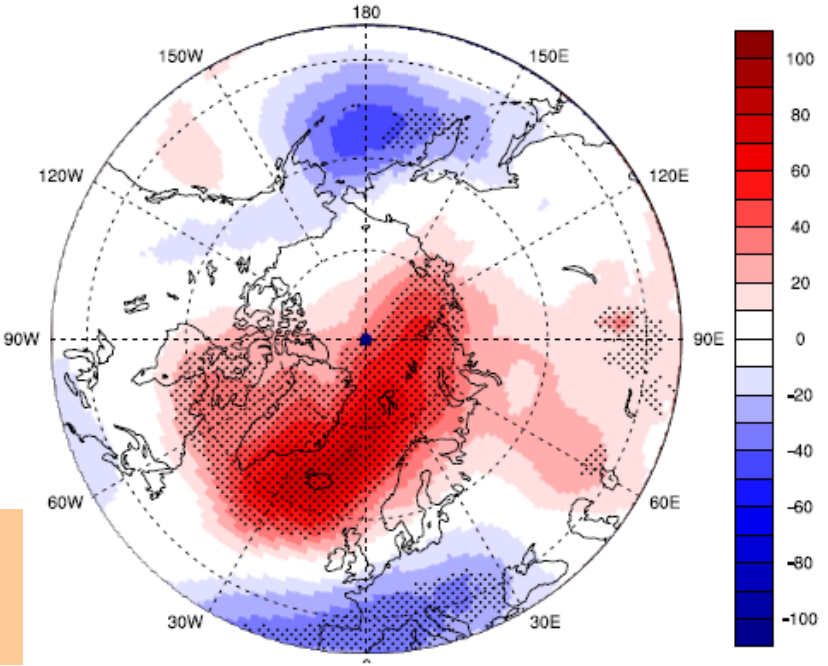
NAO in DJF

- ❑ **Re-run of ASF-20C (21 members) with swapped initial land conditions (incl. snow)**
- ❑ **Contrasting top-5 members with high and low initial snow**



U in FEB

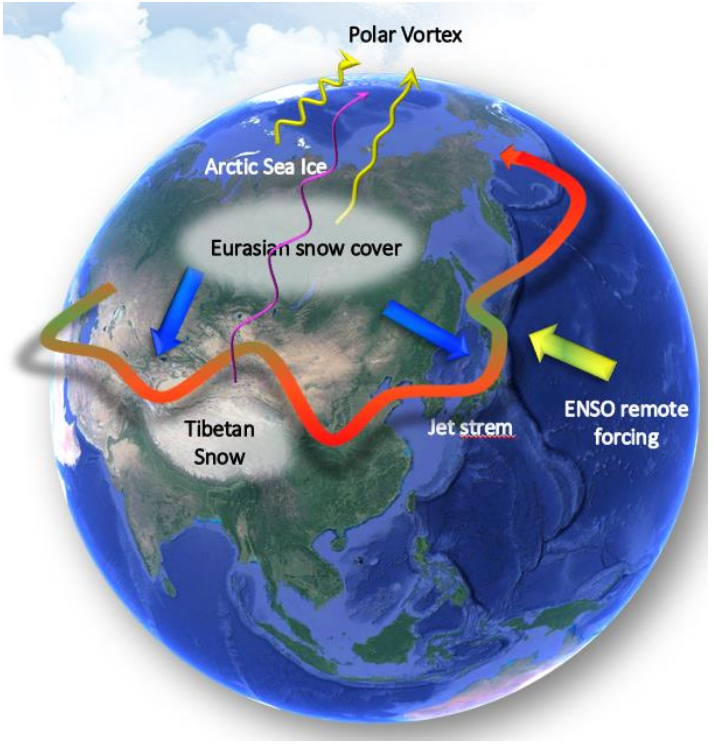
SLP in DJF



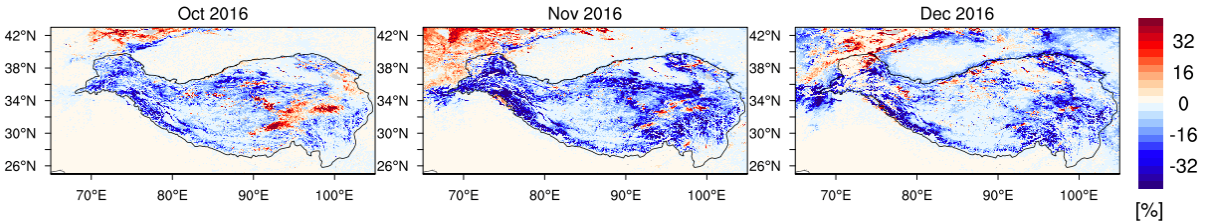
High snow :
→ negative NAO

Collaboration with M. Wegmann (WMO), A. Weisheimer (ECMWF), B. van den Hurk (KNMI)

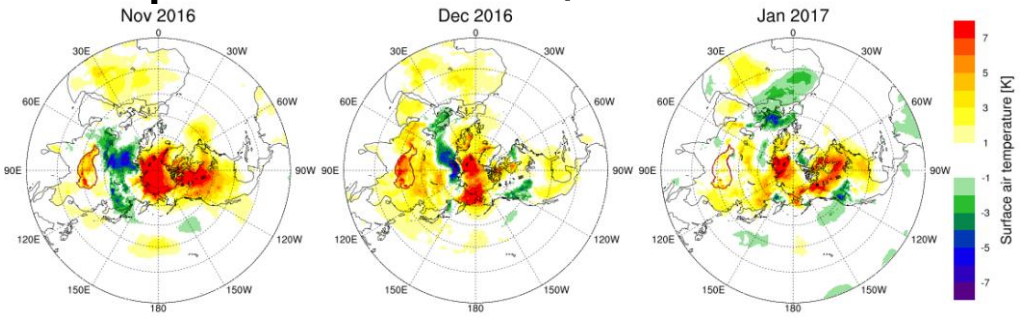
Potential remote impact of Tibetan snow on Eurasian winter climate variabilities
(Jee-Hoon Jeong)



Snow cover anomalies (IMS satellite obs.)



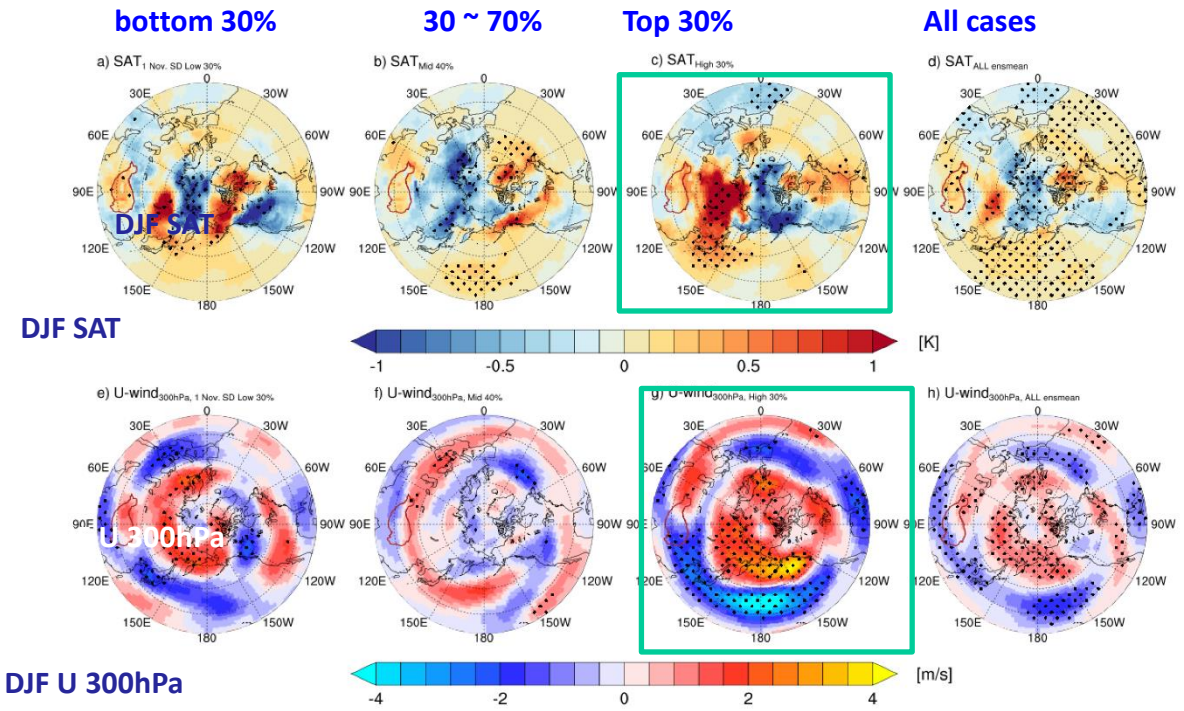
Temperature anomalies (ERA interim



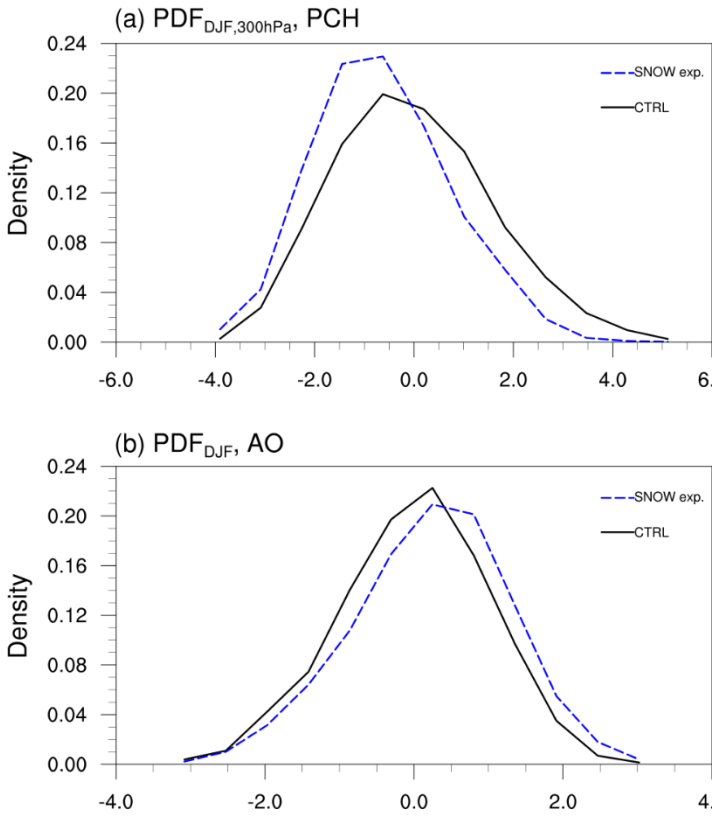
The decrease in sea ice is known to induce cold winters in Eastern Eurasia, whereas the decrease in Tibetan snow appears to be related to warm winters in East Asia.

Tibetan snow has a great potential to affect Eurasian winter climate.
CAM4 sensitivity run: response to reduced TP snow depth (1std) at Nov 1 (100 ensembles)

Composite difference of SAT (upper) and U300 (lower) anomalies for the cases, the existing snow was in the



PDF of daily Polar Cap Height (PCH) and AO index for the reduced TP snow experiment (blue) and control



Responses are quite nonlinear, but overall reflect observed features.

Impacts of Tibetan snow and Eurasian snow on Eurasian climate, and its interplay with Arctic sea-ice variabilities as well as tropical forcings need to be assessed by precisely controlled multi-model experiments – SnowGLACE

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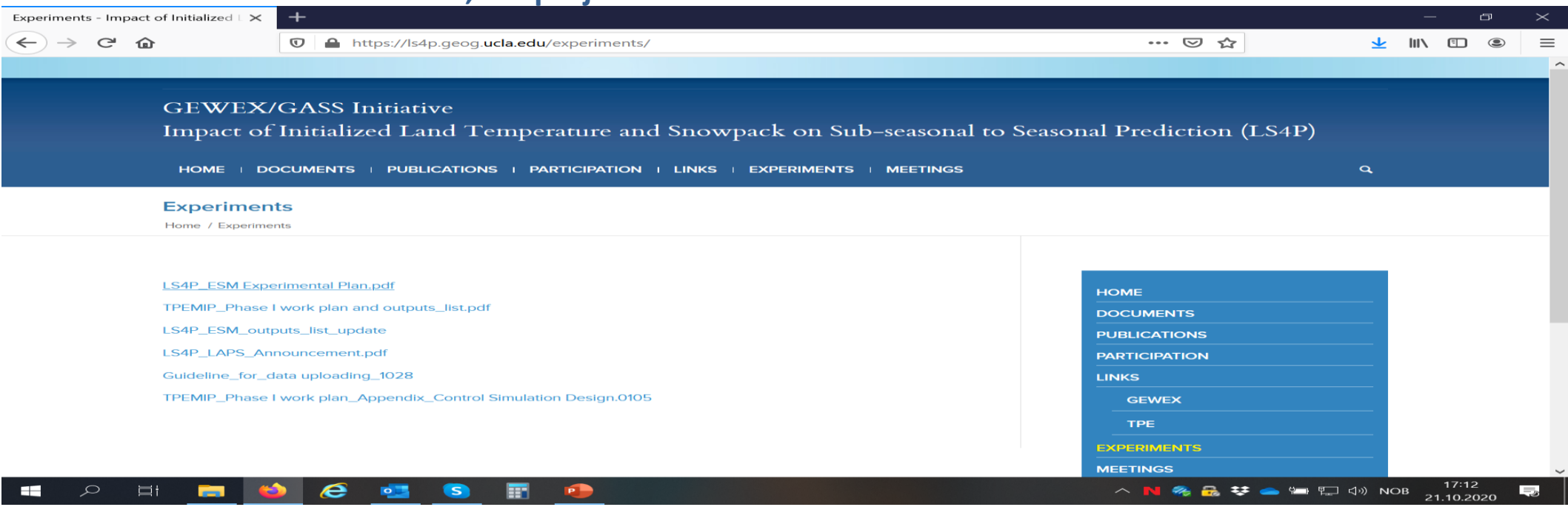
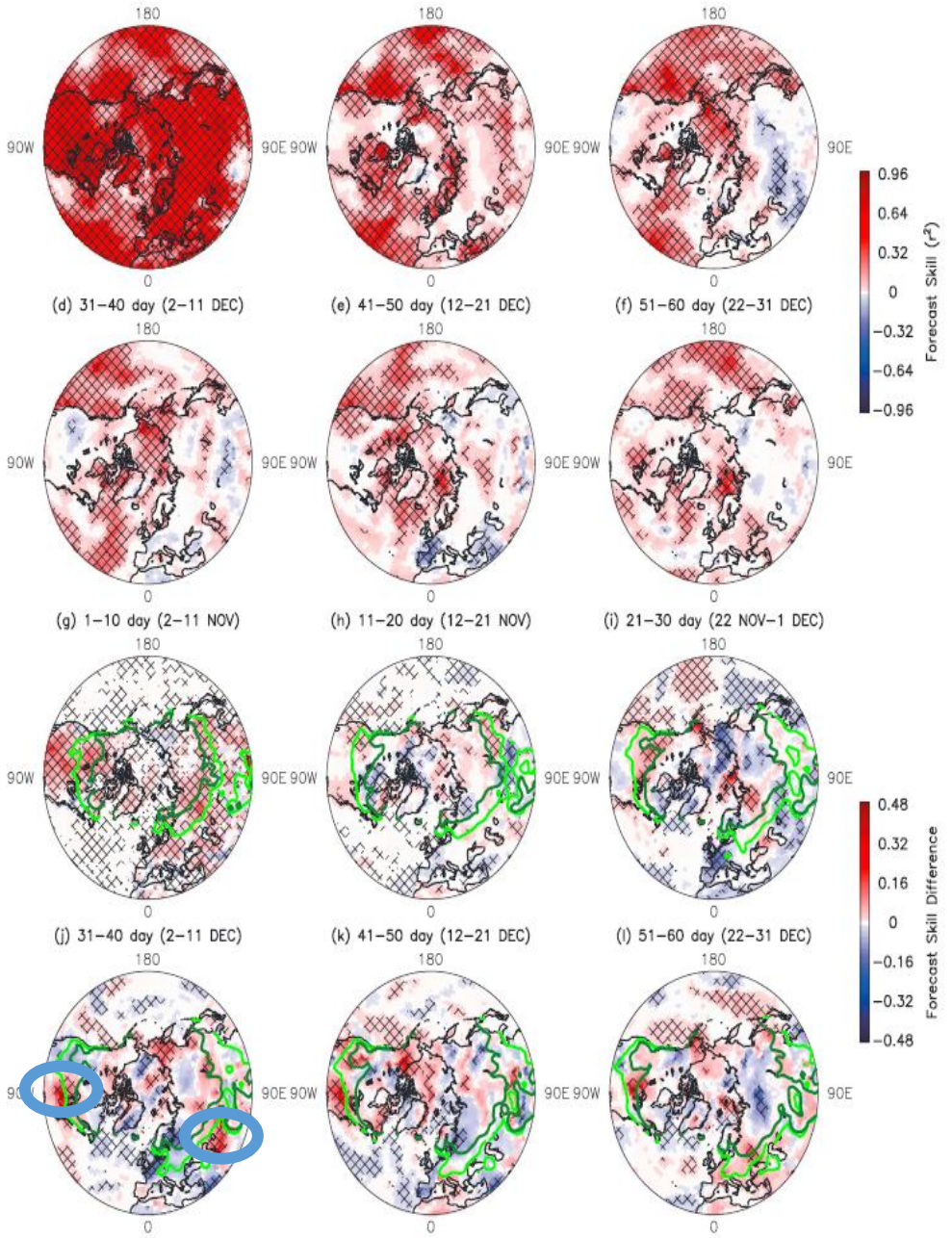
- Jee-Hoon Jeong has received a new 5-year grant in Korea, covering SNOWGLACE
- AIM : Effect of springtime snowpack over the Himalaya-Tibetan Plateau (HTP) : to facilitate multi-model comparison, we aim to propose a joint task with the GEWEX-GASS project, currently mostly subsurface temperatures and not snow per se.
- Link better with S2S Phase II, subproject on role of land



Reserve slides

Ensemble of retrospective S2S winter forecasts (1985-2016) with Norwegian Climate Prediction Model (NorCPM)



Skill for T2m: Series 1
(realistic initialisation)

6 lead times (0-day to 50-day)
start date : NOV 1

Skill increment : Series 1 minus Series 2
(gain from realistic vs. degraded snow initialisation)

<u>Moderate skill increment (0.3-0.5) in snow transition regions</u>
(green contours), e.g. at 1-month lead
(analogous to soil moisture – Koster 2010)

F. Li, Y. Orsolini, N. Keenlyside, M.-L. Shen, F. Counillon, Y. Wang, Impact of snow initialisation in subseasonal-to-seasonal winter forecasts with the Norwegian Climate Prediction Model , JGR-Atmosphere special issue on Bridging Weather and Climate: Subseasonal-to-Seasonal (S2S) Prediction, vol. 124, 2019