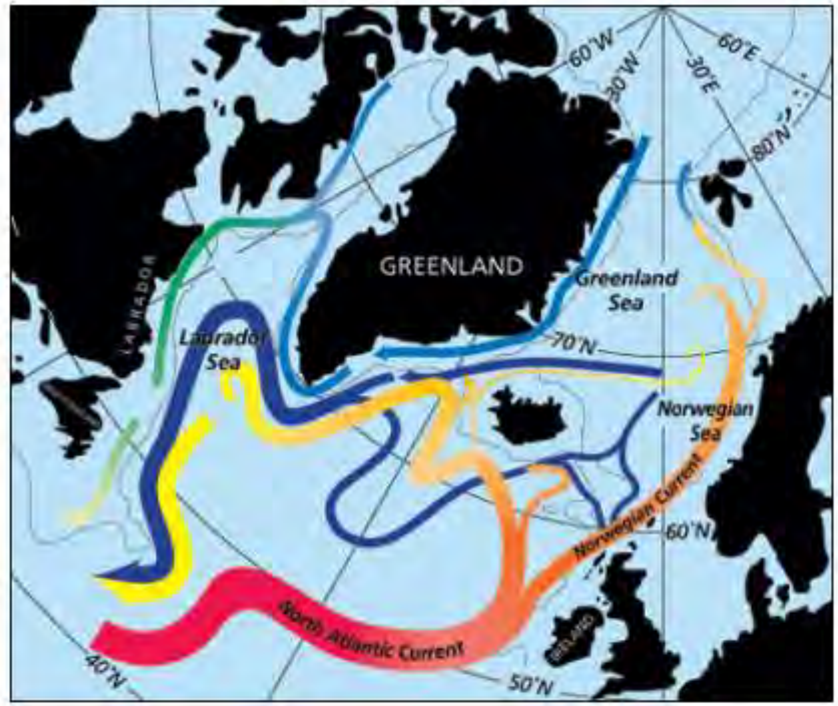
Bjerknes Centre for Climate Research

EPOCASA Project:

To improve our understanding of seasonal-to-decadal predictability in the Atlantic Sector

- Development of a Climate prediction system
- Predictability of Subpolar Gyre
- What mechanisms support the predictability?
- How to enhance the predictability base on our understanding?

- Tool: Norwegian Climate Prediction model (NorCPM)

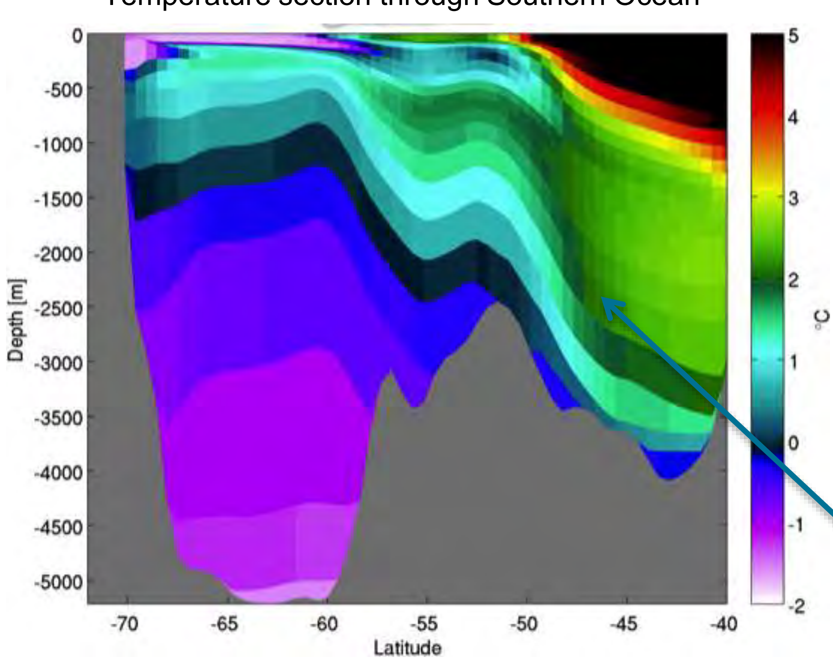


uni Research

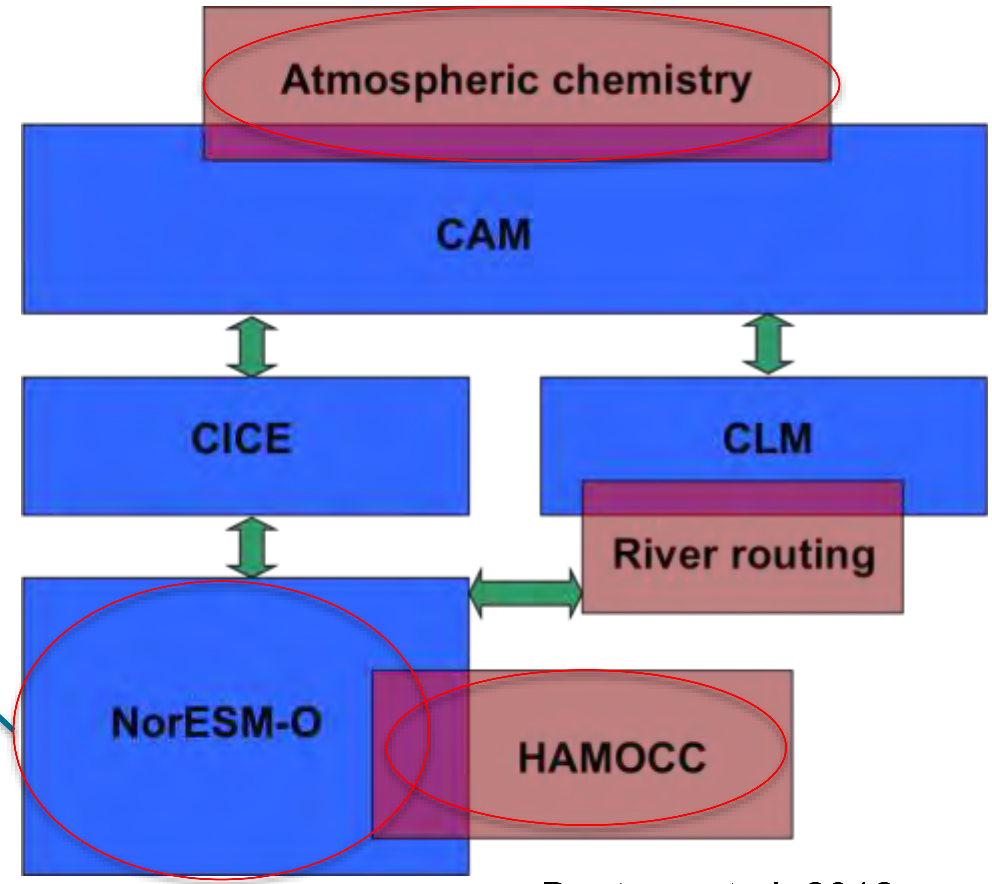
Norwegian Earth System Model (NorESM)

Based on NCAR's Community Earth System Model version 1 (CESM1)

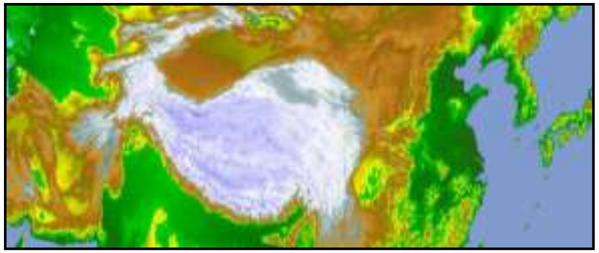
Temperature section through Southern Ocean

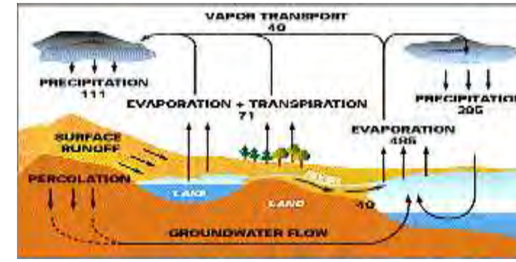


Isopycnic coordinate ocean model with a bulk mixed layer on top



Bentsen et al. 2012





Influence of springtime Himalayan-Tibetan Plateau snow on the onset of the Indian summer monsoon

Yvan J. Orsolini[1,2]

Collaborators : **Retish Senan[3], Antje Weisheimer[4], Gianpaolo Balsamo[4], Emanuel Dutra[4], Frederic Vitart[4]**

[1]Norwegian Institute for Air Research - NILU, Kjeller, Norway
[2]University of Bergen, Norway
[3]Department of Geosciences, University of Oslo, Oslo, Norway
[4]ECMWF, Reading, UK

NORINDIA

NORINDIA project funded by the Research Council of Norway (2012-2015)

Climate Change and its Impacts on Selected Indian Hydrological Systems using Earth System and High-Resolution Modeling

Coordinator: Michel Mesquita (University of Bergen)

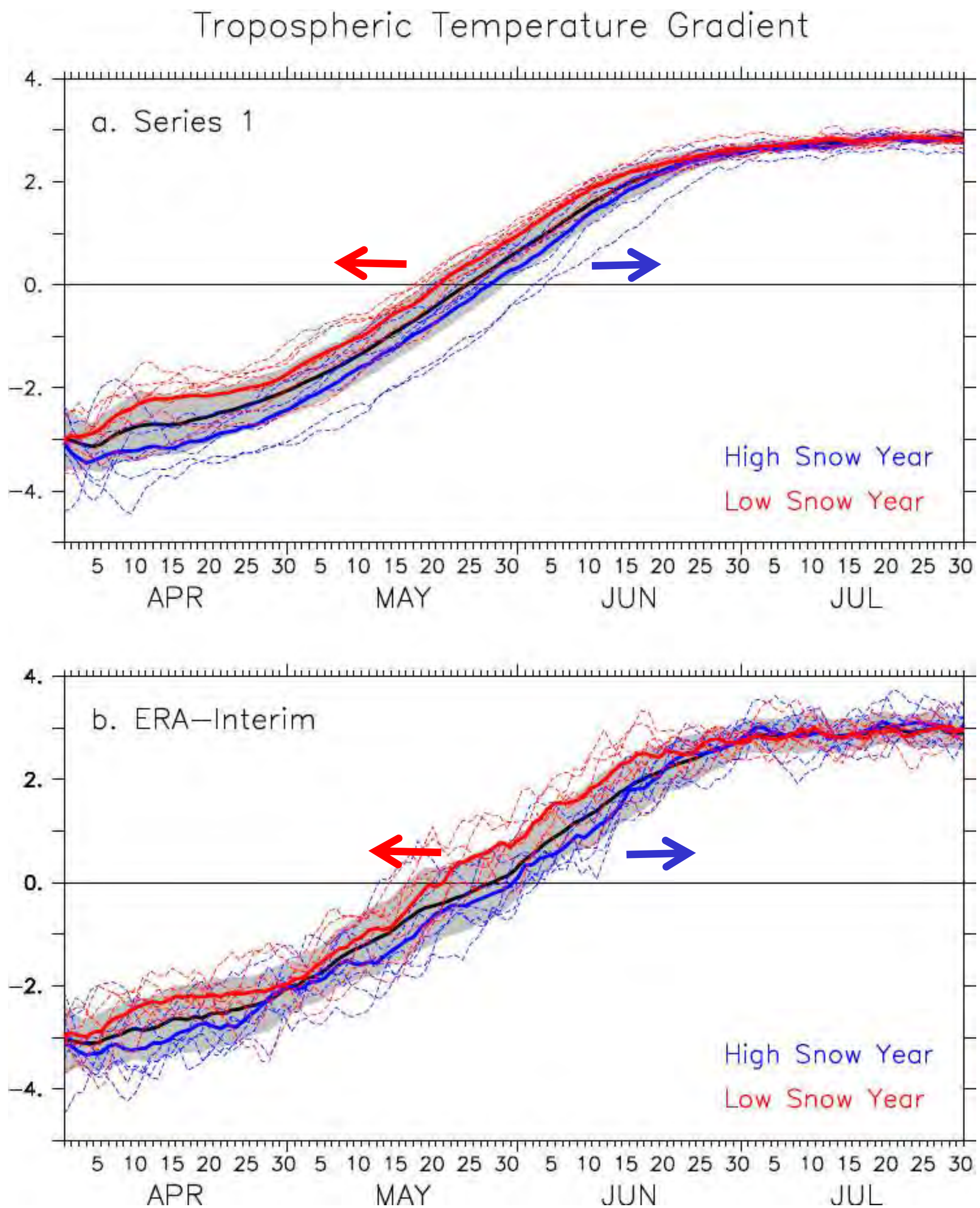
NILU

Attribute the impact of snow initialisation over the Himalaya-Tibet Plateau region (HTP) on the Indian summer monsoon <u>onset</u> in actual predictability experiments

- Revisit the "Blanford hypothesis" with a state-of-the-art ensemble prediction system
- Coupled ECMWF seasonal forecasting system in operational mode, plus dedicated experiments
- Verification : ECWMF Atmospheric or Land Re-analyses

HTP

ISM ONSET as reversal of North/South tropospheric temp. gradient

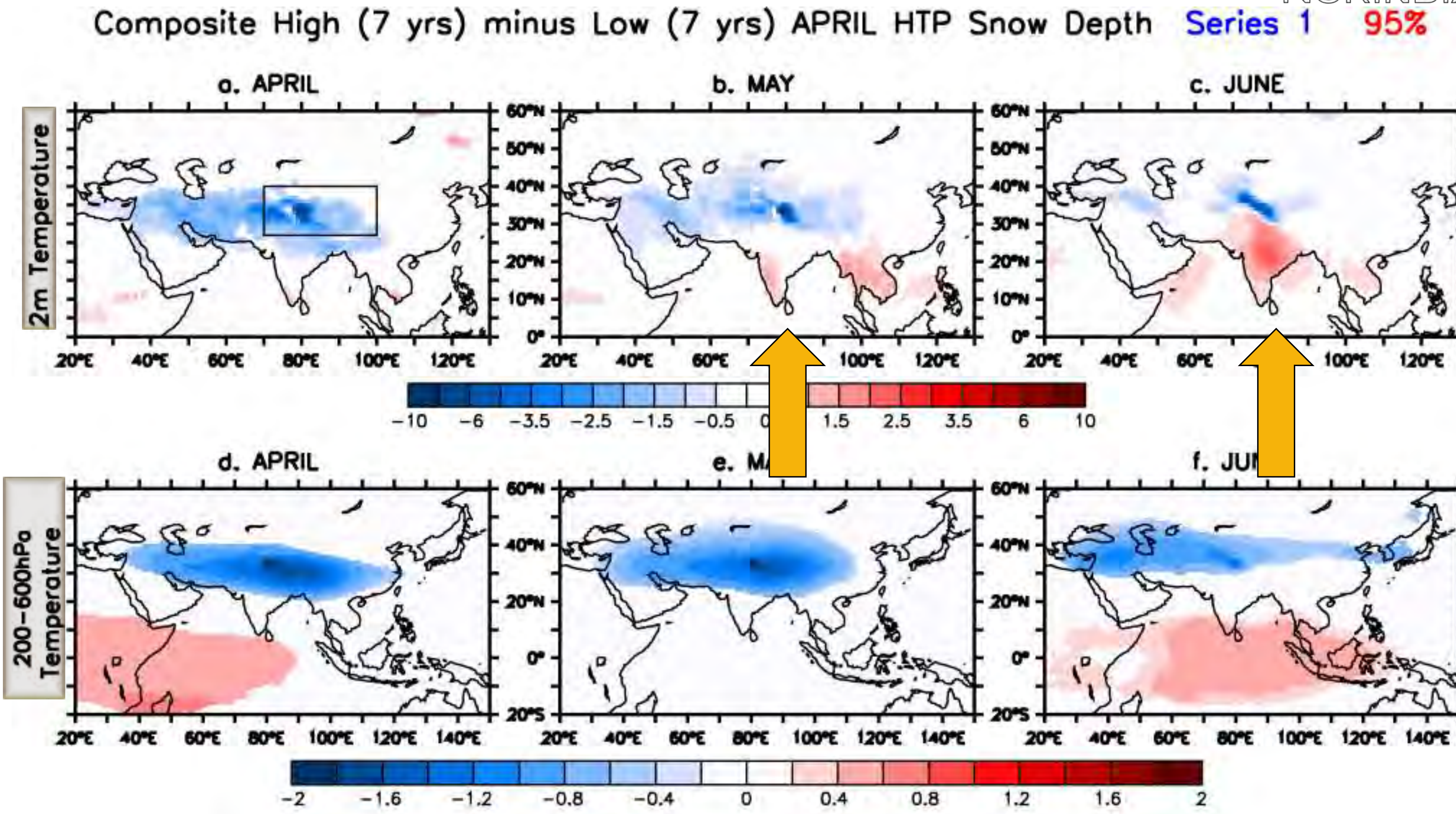


- **Reversal occurs earlier/later (← or →) or later in May in low/high April snow years over HTP region**
- **Average delay in onset is about 1 week**
- **Note: onset corresponds at a lead time : 2 months**
- **Note: S1 is the (smooth) ensemble mean**

Based on (Xavier et. al, 2007)

- **TTG : difference of the vertically integrated (200-600hPa) temperature, between a northern region (5°N-35°N) and southern region (15°S-5°N) over 40°E -100°E**
- **Onset of the monsoon: TTG zero-crossing (in late May)**

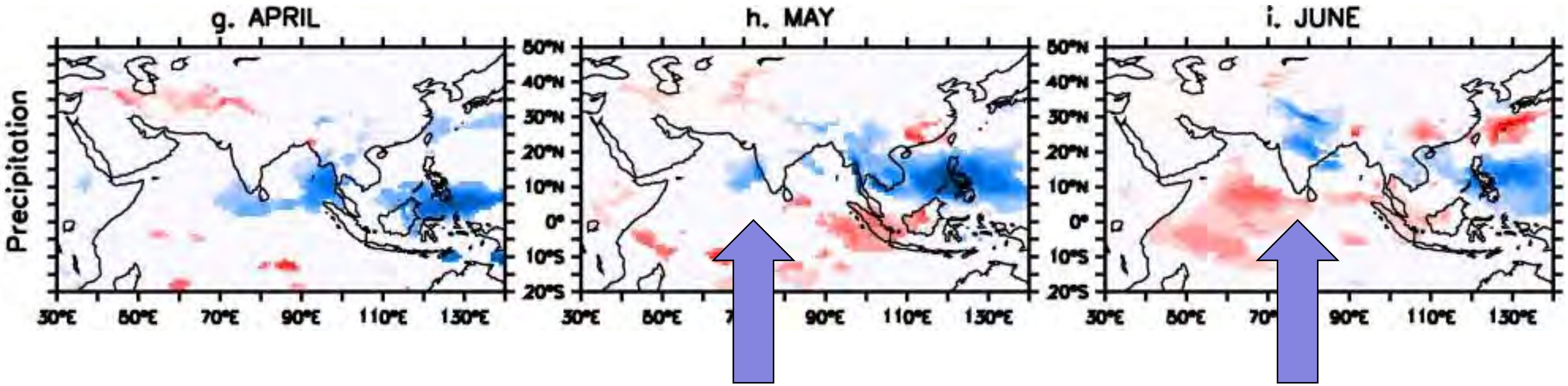
Snow composite differences: temperature



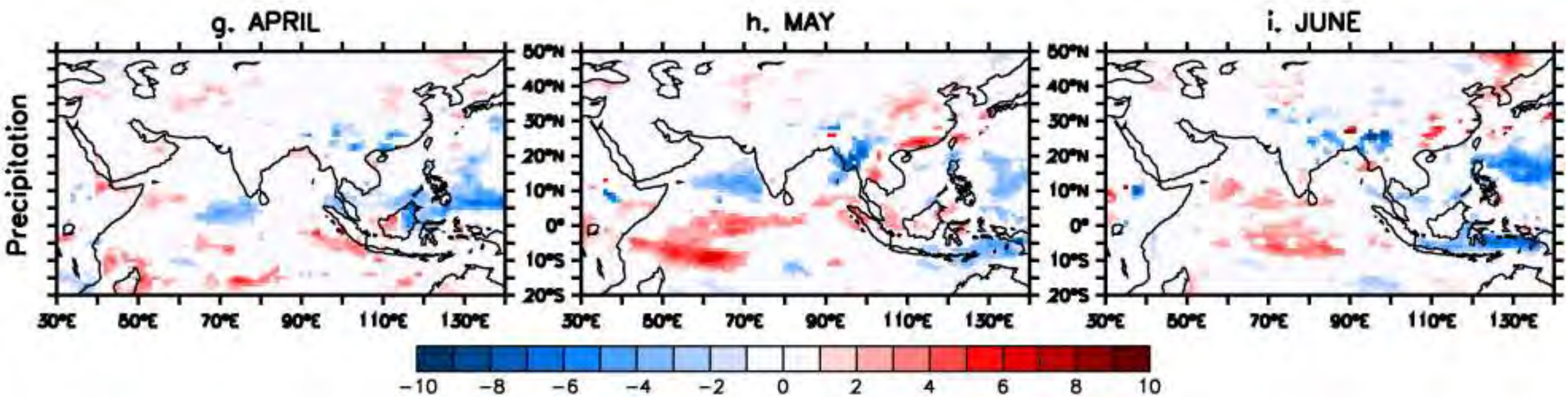
- High APRIL HTP SNOW: warm anomaly in MAY-JUNE over India
- Consistent with delayed monsoon

Snow composite differences: precipitation

Series1

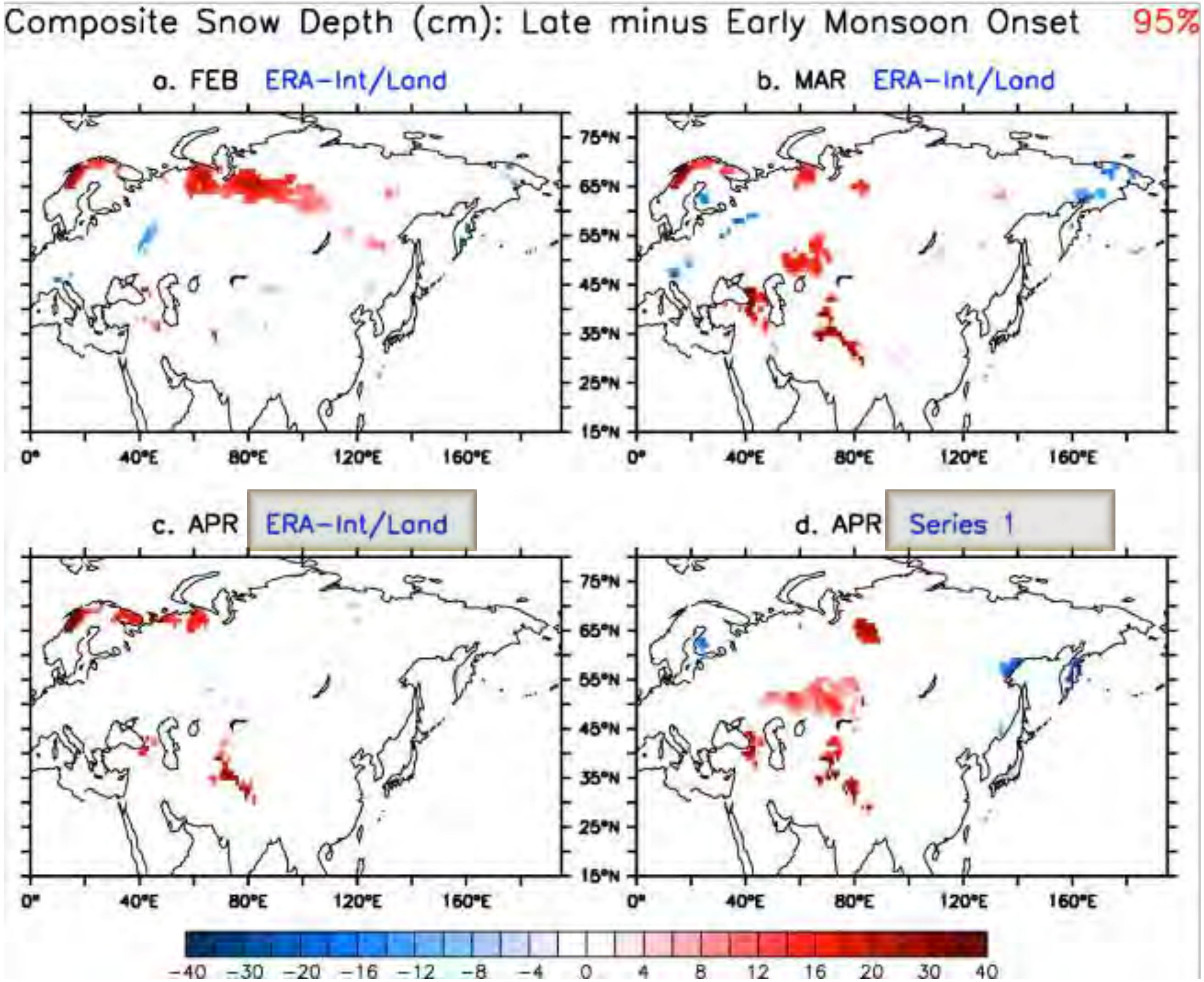


ERAINT



- High APRIL HTP SNOW (model): precipitation deficit in MAY over Arabian Sea/Bay of Bengal and in JUNE over Indian subcontinent
- Consistent with delayed, weak monsoon

Monsoon Onset Composite
(Reciprocal relation)

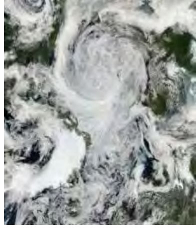


APRIL →

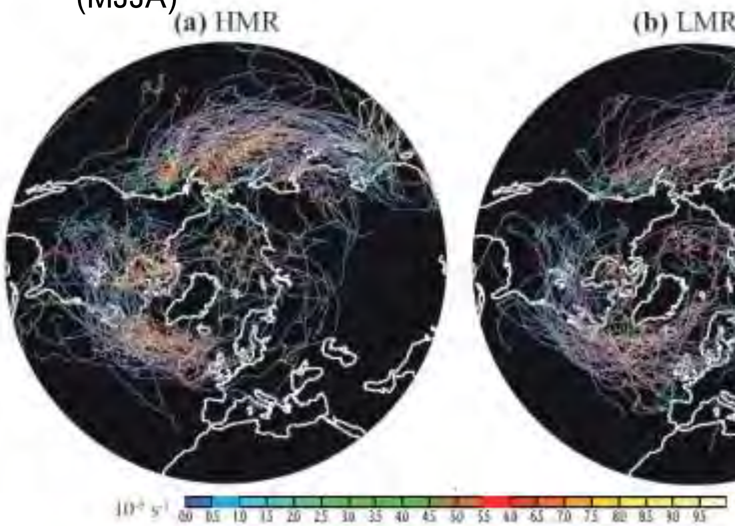
- Late onset consistent with high HTP SNOW anomaly in APR (precursory signal)

Summertime Arctic circulation and storm track

AUG 2012



Paths of major summer storms in high and low sea-ice melt months (MJJA)



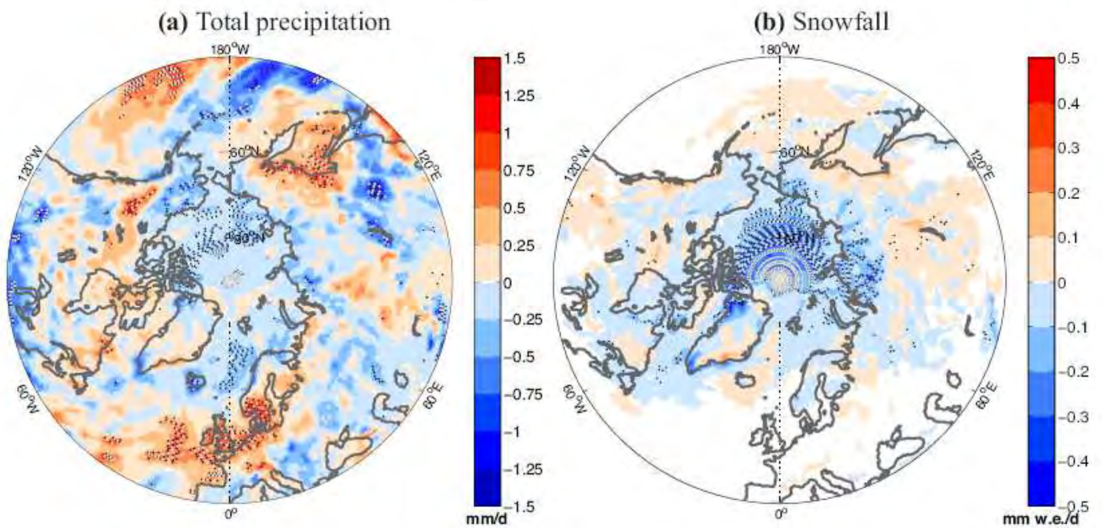
Summer months with high sea ice melt rates (HMR) have

- ❑ fewer storms, less precipitation and snowfall over the Arctic.
- ❑ Enhanced precipitation over northern Europe (Great Britain, Scandivania)

✓ *Previous work by Screen et al. (2011; 2013), Tang et al. (2013)*

➢ To investigate role of cryosphere in forecasts

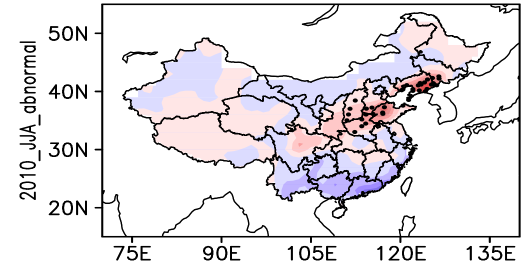
Knudsen, E., Orsolini, Y.J., Furevik, T. and K. Hodges, Observed anomalous atmospheric patterns in summers of unusual Arctic sea ice melt, *J. Geophys. Res,*, 2015.



Anomalies of precipitation and snowfall (MJJA)

Summertime wavetrains from Atlantic to the Far East in 2010

Precip anom. China



Høvmueller plot

V 200 hPa

AUGUST 2010

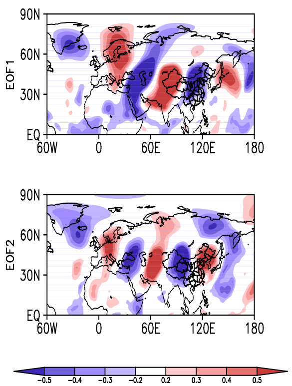
Monthly fc

Init. AUG 1

ECMWF IFS

ERAINT | **ENS MEAN** | **Indivual members**

Indivual members



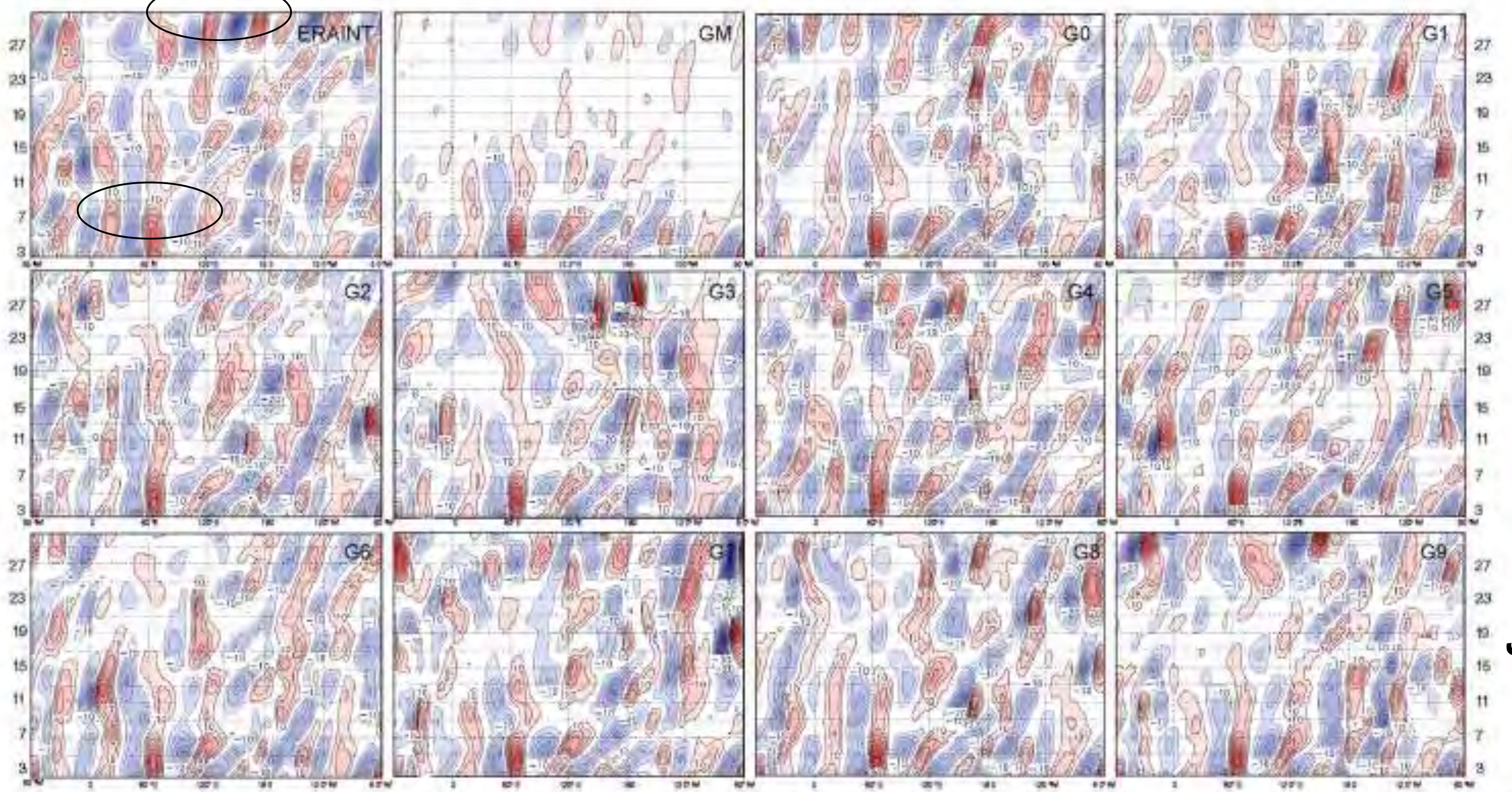


Figure 7. Hovmüller plots of meridional wind anomaly at 200 hPa throughout August 2010 in the latitude band 40–45°N, in ERA-Interim, in the ensemble mean and in all members. Model anomaly is calculated from a 10-year climatology (2000–2009). G0–G9 correspond to individual members and GM to the ensemble mean. Contour interval is 5 m/s.

Eastward-propagating wavetrains important for summertime monthly forecast of precipitation over Far East

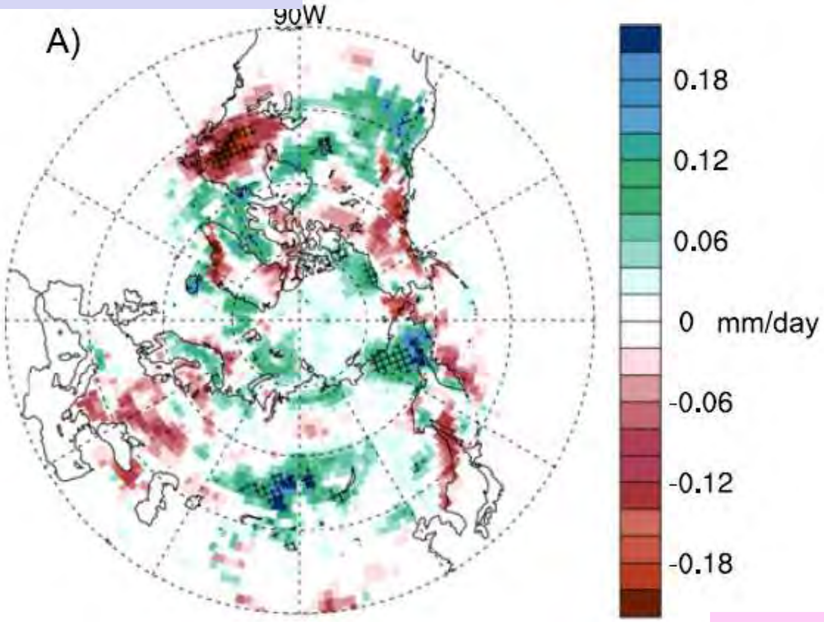
(e.g extreme precipitation event in August 2010) by Orsolini Y., Zhang L., Peters D., et al., QJRMS 2015

«DecCen» project, funded by Research Council of Norway (2011-2014)

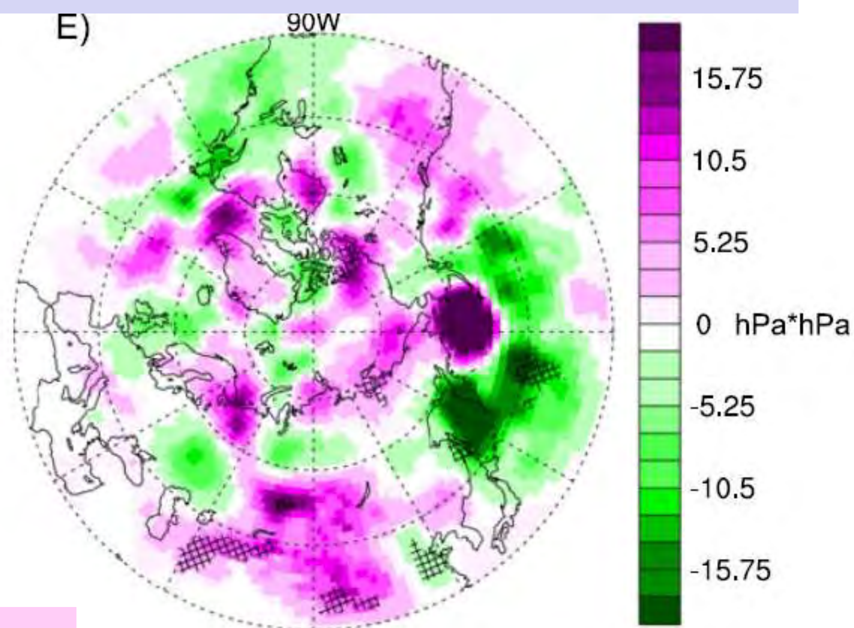
Arctic moisture source for Eurasian snow cover variations in autumn (Env. Res. Lett. - May 2015)

Martin Wegmann[1], Yvan Orsolini[2], Marta Vázquez[3], Luis Gimeno[3], Raquel Nieto[3], Olga Bulygina[4], Ralf Jaiser[5], Dörthe Handorf[5], Annette Rinke[5], Klaus Dethloff[5], Alexander Sterin[4] and Stefan Brönnimann[1]

Snow depth



Storm track activity (SLP variance)



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September Barents-Kara Sea ice

Composite difference

Low – High Sea ice

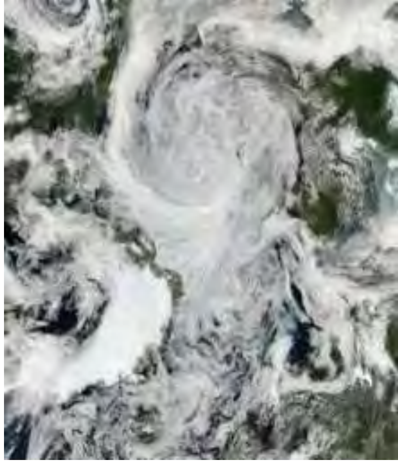
November

Low Sea Ice Barents-Kara sea correspond to :

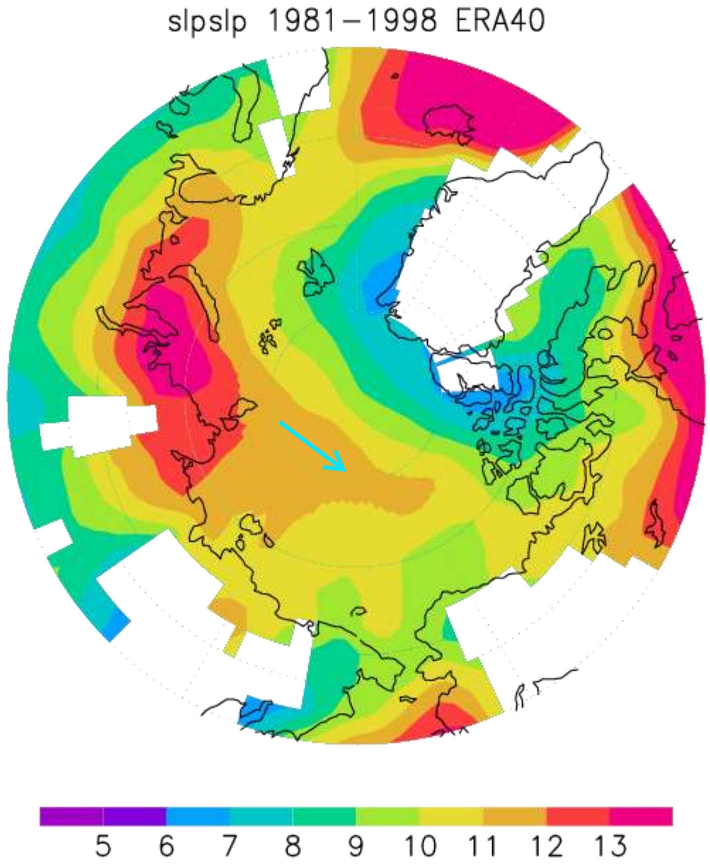
- → **Enhanced snow depth over Southwestern Siberia (supported by in-situ Russian data)**
- → **«Corridor» of enhanced storm track activity**
- → **Source of moisture is ice-free Barents-Kara sea (lagrangian trajectories)**

«ACPCA» EU-Russia cooperation project, funded by Research Council of Norway (2013-2015)

Summertime Arctic circulation and storm track



AUG 2012



Climatological Arctic summer storm track and Arctic Ocean Cyclone Maximum

Nishii, K., H. Nakamura, and Y.J. Orsolini (2014) Arctic summer storm track in CMIP3/5 climate models, Clim. Dyn.